

BalticSTE SYMPOSIA RETROSPECTIVE: FIVE MILESTONES IN SCIENCE AND TECHNOLOGY EDUCATION (2015–2023)



Vincentas Lamanauskas



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Šiauliai, 2025

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RETROSPECTIVE: FIVE MILESTONES
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FOREWORD

FOREWORD



Baltic
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*“The true value of science education
is revealed when the student starts to doubt the
answers, not the questions.”*
Juozas Vaitkevičius

The book “BalticSTE Symposia Retrospective: Five Milestones in Science and Technology Education (2015–2023)” realizes the idea of retrospectively reviewing the experience of five science symposia held in Lithuania. The first BalticSTE symposium (BalticSTE2015) took place in 2015. It is worth saying that the “roots” of the symposium, in a sense, lie in more than thirty national scientific practical conferences, “Natural science education in a comprehensive school”, which have been organised in Lithuania since 1995 and take place every year. At the same time, we will mention that the XXI conference took place on April 25-26, 2025. Another source of this idea is the international IOSTE symposia, which have been organised every two years since 1979 by the International Organization for Science and Technology Education.

It is obvious that in the contemporary world, science and technology education (NSTE) is becoming more and more important not only as a source of students' knowledge, but also as a means of developing critical thinking, creativity, and problem-solving skills. Over the past decade, this field has undergone tremendous changes, driven by both technological advances and changing societal needs. BalticSTE international symposia, held from 2015 to 2023, became an important platform for scientists, researchers, teachers, and educational policymakers to discuss these changes, share innovative experiences, and create common educational solutions.

During five international BalticSTE symposia (2015–2023), extremely wide topics of natural science and technological education were examined – from specific disciplines, such as chemistry, physics, or biology, to the integration of technologies, STEM methodologies, and the realisation of sustainable development ideas in the educational process at all levels of the education system. Thematic analysis of the articles revealed that the researchers' attention was divided between four main areas: innovations in teaching methods (e.g., active teaching/learning strategies, IBSE, blended learning, game elements), the impact of technology (from simple ICT applications to artificial intelligence, 3D holograms, and IoT), the development of student and teacher competencies (critical thinking, scientific literacy, 21st century skills), social responsibility (ecological awareness, inclusive education, climate change education, etc.). It is also important to mention that an interdisciplinary approach/viewpoint has emerged – the synthesis of chemistry and mathematics fields, the integration of natural sciences into engineering or the arts (STEAM), and during the pandemic, the increased focus on distance learning and digital literacy. This variety of topics not only reflects global educational trends but also the specifics of the Baltic region. It can be reasonably stated that BalticSTE symposia have become an effective platform for examining and solving these problems, combining theoretical empirical research with practical educational solutions. And of course, international practice and experience are extremely important. BalticSTE symposia held in Lithuania play an important role in the development of science and technology education in the Baltic region and beyond. These events are not only a platform for academic discussions but also a source of practical innovation,

promoting the implementation of contemporary educational strategies and techniques. They bring together scientists, researchers, educators from the Baltic countries and abroad, thus becoming an effective instrument of international cooperation.

This book – “BalticSTE Symposia Retrospective: Five Milestones in Science and Technology Education (2015–2023)” – reflects the contribution of these events to the development and evolution of science and technology education. It analyses the main issues discussed during the symposia: from chemistry and physics teaching methods to the integration of digital technologies, from ecological awareness to the development of STEM fields. In addition, it is revealed how these events helped to respond to challenges, such as lack of student motivation, the need to train competent teachers, and rapidly changing technologies and their efficient and optimal adaptation/integration in the education process.

The five BalticSTE symposia not only recorded the current situation but also encouraged the emergence of new ideas, international cooperation, and dissemination of scientific activities on an international scale. These symposia have become an engine, helping the Baltic countries and foreign partners to modernise education, based on evidence-based practices. This book is intended not only for those who participated in the BalticSTE events, but also for everyone who cares about the future of natural science and technology education. We hope that this work will become a valuable resource for researchers, teachers, and educational policymakers who seek to improve the education system and prepare the young generation for the challenges of the 21st century.

SCIENTIFIC PUBLICATIONS OF THE BalticSTE INTERNATIONAL SYMPOSIA: TRENDS AND SHIFTS IN SCIENCE AND TECHNOLOGY EDUCATION THEMES (2015–2023)

**SCIENTIFIC PUBLICATIONS OF THE BalticSTE
INTERNATIONAL SYMPOSIA: TRENDS AND
SHIFTS IN SCIENCE AND TECHNOLOGY
EDUCATION THEMES (2015–2023)**



BalticSTE (Baltic Science and Technology Education) is an international scientific event dedicated to the issues of *Science & Technology Education* (STE) in the Baltic states and beyond. The first international symposium took place in 2015. It can be reasonably said that the ideological platform of this symposium was the national scientific practical conference “Science education in general education school”, organised every year since 1995. Five international symposia took place from 2015 to 2023. It is obvious that these symposia brought together researchers, scientists, educators, policymakers, and other persons interested in science and education technology from various countries and institutions.

Natural Science and Technology Education (NSTE) promotes critical thinking, creativity, and problem-solving skills that are necessary for the 21st century job market. Productive discussions about best practices and the latest technologies help modernise education and adapt it to the rapidly changing world reality. BalticSTE symposia provide opportunities for the Baltic countries and foreign partners to exchange experiences, design joint educational solutions, and strengthen the scientific potential of the region.

In recent years, both in Lithuania and in other countries, much attention has been paid to the development of natural sciences and technologies. The declining interest of young people in natural sciences and/or technologies is of great concern (Lamanauskas, 2015b). Thus, one of the main goals is to strengthen natural sciences and technology education. It must be said that the state of NSTE in Lithuania in the period from 2015 to 2025 experienced significant changes related to the improvement of educational policy, infrastructure, and teaching methods. Undoubtedly, during this period, this area has improved significantly, both in terms of infrastructure and methodology. Although natural sciences education in Lithuania has made significant progress over the past 10 years (technologies, international projects, STEM centres), structural problems remain (shortage of natural sciences teachers, low student motivation, etc.).

So, as already mentioned, five international BalticSTE symposia took place. During them, a lot of scientific, methodological, practical reports of various kinds were made, practical work and seminars were organised. Of course, scientific articles were published. A total of 150 articles were published (Table 1).

Table 1
BalticSTE Symposium Publications

Year	Number of publications	Number of countries	Number of authors
2015	33	12	68
2017	34	16	65
2019	44	21	93
2021	16	13	27
2023	23	13	43

All publications are open access; they can be found on the symposium website, as well as in the databases CEEOL, ERIC, Scribd, DOI, Crossref, Internet Archive, Google Scholar, etc.

An analysis of the published articles was carried out according to the most important thematic areas. In total, the articles are divided into seven thematic/subject areas. Although this division is partly conditional, certain trends can be discerned (Table 2).

Table 2

Distribution of Published Symposium Articles by Thematic Areas (N (%))

Area / Subject	2015	2017	2019	2021	2023	Total
Chemistry Education	10	8	8	3	6	35 (23.3)
Physics Education	2	5	6	3	2	18 (12)
Biology Education	0	3	3	1	1	8 (5.3)
Ecology and Environmental Education	0	4	2	0	4	10 (6.7)
Educational Technology	7	2	7	3	3	22 (14.7)
STEM Education	0	0	2	2	0	4 (2.6)
General articles	14	12	16	4	7	53 (35.4)
Total	33	34	44	16	23	150 (100.0)

As can be seen in Table 2, the largest proportion of articles was of a general nature (35.4%), in which common natural sciences and technology education topics, trends, and methodological questions were analysed. The second largest group of articles was devoted to chemistry education (23.3%). This shows that a significant portion of scientific research is devoted to the issues of chemistry education. Articles on educational technologies account for 14.7%, reflecting the growing integration of technologies into the learning process. Articles on physics education account for 12%, biology – 5.3%, ecology and environmental protection – 6.7%. The least attention was paid to STEM (integrated science, technology, engineering and mathematics education) (2.6%). This may indicate a less developed direction of research on STEM topics or the need for its integration in the future.

General trends show that most attention is paid to general issues of natural science and technology education, but there is also a clear orientation towards specific disciplines (especially chemistry), as well as towards the growing role of technology in the educational process.

After analysing the presented list of 150 symposium articles, it is possible to distinguish several main thematic directions and their change from 2015 to 2023. Of course, such a division is rather conditional, but in any case, it allows us to discern certain aspects of thematic changes. When it comes to publications in 2015, it can be seen (Lamanauskas et al., 2015) that attention is focused on general topics of natural science and technology education, such as the effectiveness of educational methods, educational competencies, students' interest in natural sciences and mathematics. The issues of chemistry teaching are relatively actively analysed, emphasising educational strategies (e.g., critical thinking, interdisciplinary integration, etc.). It can also be argued that the

use of educational technologies is expressed as an important trend, with a relatively large number of articles on the application of information communication technologies in the classroom.

There are 34 articles published in the 2017 symposium publication (Lamanauskas, 2017). It can be noted that there is a stronger focus on interdisciplinary topics and environmental education. Undoubtedly, a more intensive analysis of physics teaching and ecological education topics is noted. Teacher professional development and the application of active learning strategies (for example, inquiry-based learning (IBSE), problem solving, conscious learning) have become much more significant topics (research areas).

The largest number of articles, as many as 44, were published in the publication of the fourth symposium held in 2019 (Lamanauskas, 2019). It is undoubtedly noticeable that the attention to educational technologies and digital tools in the educational process has increased significantly. Student assessment and self-assessment strategies, as well as formal assessment, have become much more prominent. The integration of the STEM direction is clearly noticeable, although there are few articles, but for the first time, it clearly stands out as a separate area. It should be noted that there is a clearer focus on teachers' pedagogical knowledge and competencies, especially in the context of physics and chemistry teacher training.

In 2021, the symposium was held remotely (Lamanauskas, 2021). This situation arose due to the prevailing COVID-19 pandemic. This is also reflected in the number of articles prepared for publication. Only 16 were published that year. Despite the noticeably smaller number of articles (possibly due to the influence of the pandemic), there is a clear focus on the teacher and students' ability development, taking into account the 21st century competencies. Particular emphasis is placed on digital education, digital competencies, distance and integrated teaching/learning. Students' cognitive abilities and the development of scientific thinking have begun to be assessed and analysed more.

The fifth international BalticSTE2023 symposium took place after the pandemic period, in 2023. (Lamanauskas, 2023). Analysing the published articles, it can be seen that the integration of modern technologies is emphasised (e.g., 3D holograms, chatbots, IoT (Internet of Things), interactive content, etc.). The topics of the publications (and, of course, the research conducted) are clearly oriented towards developing practical skills, solving ecological issues, and raising public awareness (e.g., biodegradability, environment preservation, etc.). There is also a greater focus on inclusive education, teaching students with special needs, and teaching differentiation.

It is not very reliable to talk about certain trends or directions of this period on the basis of publications, but some directions can be discerned. One could probably talk about certain insights, observations, rather than very clear directions. However, this helps to understand the general problematic of educational research in the field of NSTE more clearly. For example, by reviewing the publications from 2015 to 2023, the direction of technological breakthroughs and digitalisation is observed. If in 2015 there were only individual publications on educational technologies, then later it became practically one of the most important research directions. One cannot fail to notice a rather clear trend – this is technology integration into education, starting from simple computer programs and moving on to complex interactive technologies, such as 3D holograms, IoT, virtual or augmented reality tools. Also, increasing attention is paid to interdisciplinary interfaces

(especially chemistry and mathematics, chemistry and biology), the development of problem-solving skills, and integrated STEM / STEAM directions. As researchers rightly note, it is increasingly recognised that STEM knowledge is a priority in the development of education (Cedere et al., 2020). In addition, access to STEM enables students to become more creative thinkers and problem solvers, with the necessary abilities and skills to solve everyday problems and issues in new and innovative ways (Siew, 2017). Another noticeable direction is ecology and sustainable development. Growing attention to ecological education and environmental awareness is observed especially in works published in 2017 and 2023.

Another noticeable direction is associated with the development of students' cognition and competence. Intensive attention is paid to the development of students' cognitive abilities (metacognition, scientific thinking, research skills, etc.). The need to develop 21st-century skills (critical thinking, creativity, the ability to solve complex problems, etc.) is particularly evident. For example, research results show that students with higher cognitive needs often have better academic performance and greater willingness to engage in cognitively demanding activities (Popoviciu et al., 2011).

Another significant trend is also noticeable, which is associated with the evolution of educational methods and techniques. It can be conditionally stated that there is a transition from conventional educational methods to research-based, interactive, problem-based teaching and formative assessment methodologies. In turn, the development of teachers' pedagogical knowledge and competencies is becoming an integral part of scientific and practical research. Researchers note that the goal of teacher education is to prepare a teacher able to master teaching innovations and acquire professionally valuable competencies (Kobalia & Garakanidze, 2010). Promoting an independent learning environment, using everyday contexts and situations, raising challenges for students through open activities, and promoting epistemic practices (e.g., focusing attention, describing, communicating, and reasoning) are significant teacher competencies (Pinto et al., 2014).

After analysing the scientific publications of the 2015–2023 BalticSTE international symposia, it can be stated that the change in the topics of natural science and technological education reflects both global trends in educational development and specific regional needs and challenges. Several important directions have noticeably emerged: the strengthening role of technologies and digitalisation in education, increasing attention to an interdisciplinary and integrated STEM approach, the application of active and innovative teaching methods, and a significant emphasis on ecological and sustainable development. In addition, there is a growing attention to the teachers' professional development, strengthening of their pedagogical competencies, especially focusing on the ability to apply modern technologies, and interactive teaching (learning) strategies. Although the division of thematic areas is partly conditional, it allows us to clearly see the trends and changes over the past years. A clear necessity is seen to further develop STEM education, promote students' motivation and interest in natural sciences and technologies, and strengthen students' skills, necessary in the 21st century. BalticSTE international symposia, held from 2015 to 2023, are undoubtedly an important platform for scientific research and discussions on natural science and technology education.

RETROSPECTIVE OVERVIEW OF THE BalticSTE INTERNATIONAL SCIENTIFIC SYMPOSIA

**RETROSPECTIVE OVERVIEW OF THE BalticSTE
INTERNATIONAL SCIENTIFIC SYMPOSIA**



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FIRST SYMPOSIUM: BalticSTE2015

Improving natural science and technology education remains a key challenge. In a context of declining interest among young people in science and technology, it is important to find effective ways and means of motivating and shaping interests. This was the focus of the first BalticSTE2015 International Science Symposium in the Baltic region, which took place in Šiauliai on 15-18 June 2015. The event's main theme was "The present and prospects of science and technology education". The symposium was organised by the scientific methodological centre "Scientia Educologica" and the Research Centre for Science Education of Šiauliai University. Such a symposium was organised in Lithuania for the first time after restoring Lithuania's independence in 1990 (1st International Baltic Symposium on Science and Technology Education (BalticSTE2015)).

The symposium was welcomed by the Vice-Rector of Science and Arts of Šiauliai University, Dr Diana Šaparnienė, and the Dean of the Faculty of Education, Dr Erika Masiliauskienė. A short musical greeting was performed by the Šiauliai S. Daukantas Gymnasium student ensemble.

Researchers from various foreign countries attended the symposium. Despite being a Baltic Symposium, it was open to all interested parties. As far as the region is concerned, it is important to emphasize that it is of particular importance not only to bring together foreign scientists but also to demonstrate the experience of the Baltic countries, in particular Lithuania, Latvia, and Estonia, in the field of science and technology education. Symposia of this kind are regularly held in Asia, Africa, South or North America and are primarily aimed at promoting the development of science in the region. This symposium was attended by guests from Taiwan, Brazil, Canada, Turkey, Iran, Russia, Slovenia, Slovakia, Czech Republic, Italy, Latvia, and Poland.

Traditionally, 6 plenary lectures were delivered on the first day of the symposium. The authors and topics are listed in Table 1.

Table 1
Information on Plenary Presentations

Author(s)	Institution, country	Title of the report/presentation
Vincentas Lamanauskas	Šiauliai University, Lithuania	Natural science and technology education: "Resetting" meaning
Kuohung Huang	National Chiayi University, Taiwan	Mobile learning and outdoor science education: Studies of zoo field trips
Martin Bilek	University of Hradec Kralove, Czech Republic	Synergy and/or mismatch of real and virtual environment in science education
Paolo Bussotti	University of Udine, Italy	How history of mathematics can be used in mathematics education to teach differential and integral calculus
Kateřina Chroustová, Martin Bilek	University of Hradec Kralove, Czech Republic	The development of factors affecting the usage of educational software in chemistry education in the Czech Republic
Lukáš Vizek	University of Hradec Kralove, Czech Republic	On volume of the antiprism in cube as a complex mathematical problem

Seven posters were also presented on the first day of the symposium. For example, Dr Renata Bilbokaitė presented the latest research results in the field of computer visualisation, Dr Violeta Šlekienė and Dr Loreta Ragulienė presented various vision-improving methodologies, the concept of vision therapy and the necessity of prophylactic vision improvement in schools of general education. Dr Ewa Szczepanowska's poster presentation dealt with adult education, etc.

Table 2
The List of the Presentations

Section 1 <i>General S&T Education Issues</i>	Section 2 <i>S&T Education Praxis</i>
Abdeljalil Météoui, Louis Trudel. <i>Acquisition of scientific and pedagogy competences by primary pre-service teachers: Myth or reality?</i> (Université du Québec à Montréal, Canada)	Karol Dudek, Paweł Bernard, Ewa Odrowąż. <i>First steps in assessment of students- inquiry - case study of non-experienced chemistry teacher</i> (Jagiellonian University, Poland)
Eva Trnova, Josef Trna. <i>Development of science teacher creativity and IBSE</i> (Masaryk University, Brno, Czech Republic)	Āris Kaksis, Agnese Brangule, Mihails Halitovs. <i>An approach to teaching medical chemistry that highlights interdisciplinary nature of science</i> (Riga Stradiņš University, Latvia)
Liga Cakane, Jelena Volkinstiene, Dace Namsone, Ilze France. <i>What lesson observation data reveal about the changes in teaching science: Case study from Latvia</i> (University of Latvia, Latvia)	Denis M. Zhilin, Marina Tokareva. <i>Chemistry of paintings or how to involve 8-10 y.o. children for a two-hour session without breaks</i> (Moscow, Russia)
Dagnija Cedere, Inese Jurgena, Ineta Helmane, Inta Tiltiņa, Gunīta Praulīte. <i>Cognitive interest: Problems and solutions in the acquisition of science and mathematics in schools of Latvia</i> (University of Latvia, Latvia, Riga Teacher Training and Educational Management Academy, Latvia)	Marcelo Gouveia Nascimento, Gabriel Nicolas Garcia Alves, Marco Antonio Bueno Filho, Rodrigo Luiz Oliveira Rodrigues Cunha. <i>A flash of construction schemes collective in the classroom involving the field of structural molecular</i> (Federal University of ABC, Brazil)
Andrej Flogie, Kosta Dolenc, Boris Aberšek. <i>Transdisciplinarity in education is near</i> (University of Maribor, Slovenia)	Irina Kazuša. <i>Usage of critical thinking principles in medical chemistry course</i> (Riga Stradiņš University, Latvia)
Parvin Bazghandi, Saeid Zarghami-Hamrah, Yahya Ghaedi, Alireza Mahmudnia, Khosrow Bagheri Noaparast. <i>Theoretical investigation of the implications of complex systems theory for teaching science</i> (Kharazmi University, Tehran, Iran)	Inese Dudareva, Dace Namsone, Liga Cakane. <i>The use of ICT in the science lessons: Experience from Latvia</i> (University of Latvia, Latvia)
Aysan Şentürk. <i>Designing a blended learning environment to support self-directed and self-regulated learning</i> (Uludag University, Bursa, Turkey)	Tamara Brice. <i>The Importance of Creative Tasks in Physics Lessons</i> (Ogres gymnasium, 41high school, Latvia)
Mateja Ploj Virtič, Kosta Dolenc. <i>Evaluating the potentials of ICT integration in teaching with the aim of intentionally developing competencies for the 21st century in pupils</i> (University of Maribor, Slovenia)	Sergei V.Teleshov, Elena V.Teleshova. <i>Chemical experiment which was seen and carried out by gymnasium students, realists and cadets</i> (Saint-Petersburg, Russia)
Rita Birzina, Dagnija Cedere. <i>The 1st year students' readiness for studies: The case of the faculty of biology at University of Latvia</i> (University of Latvia, Latvia)	Władysław Blasiak, Paweł Kazubowski, Roman Rosiek, Mirosława Sajka. <i>The usefulness of physics formulas in the opinion of students. An eyetracking study</i> (Pedagogical University of Cracow, Poland)

Joint Section
ICT in S&T Education

Juris Porozovs, Anita Migleniece, Daina Voita, Alvis Valdemiers. *The implementation of information and communication technologies in schools of Latvia* (Riga Teacher Training and Educational Management Academy, Latvia)

Sedat Yüksel, Mestan Boyaci. *Examining the effect of animation applications on student achievement in science and technology course* (Uludag University, Bursa, Turkey)

Dzintars Tomsons, Inta Znotiņa. *Development of computer-based educational game across computer science curriculum* (Liepāja University, Latvia)

Adem Uzun. *Innovation skill development potential of teaching programming to children in the context of the STEM education* (Uludag University, Bursa, Turkey)

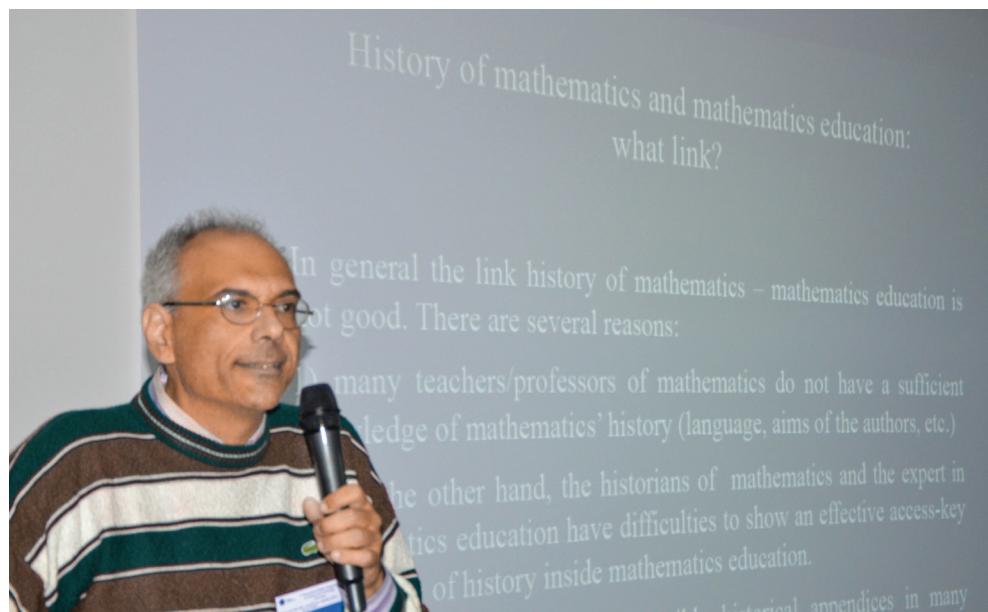
Aliya Bokusheva. *The study of computational geometry in the system mathematica* (Saratov State University, Russia)

Hanna Tryfanava. *Mobile application Socrative in improving of student progress* (Belarusian State University, Belarus)

Traditionally, Paolo Bussotti (Italy) introduced some relevant issues on how history of mathematics can be used in mathematics education to teach differential and integral calculus (Figure 1).

Figure 1

Plenary Presentation by Paolo Bussotti



Professor Kuo-Hung Huang (Taiwan) introduced some aspects of mobile learning and outdoor science education (Figure 2). Martin Bilek (Czech Republic) made another particularly significant presentation on the synergy/disparity between real and virtual environments in science education (Figure 3). The main idea is that integrating real and virtual environments in science education offers complementary strengths.

Figure 2

Plenary Presentation by Kuo-Hung Huang

**Figure 3**

Plenary Presentation by Martin Bilek

**Figure 4**

Symposium Poster



The second day of the symposium was dedicated to a field trip. The theme of the field trip was "Historical Aspects of Science and Technology Education". The participants of the symposium visited and got to know in detail the Cold War Museum, which is located in the village of Ploksciai, Plungė district (Figure 5 & 6). The museum is housed in one of the Soviet Union's first former underground ballistic missile launch complexes. The museum's historical exhibition tells the story of the five decades of the Cold War in a detailed and visual way. The exhibition is extremely varied and rich, and provides a comprehensive overview of an entire era of the 20th century.

Figure 5

Symposium Participants at the Cold War A Tour of the Cold War Museum Museum



Figure 6

A Tour of the Cold War Museum



The symposium participants also visited Palanga, explored the city's sights and got acquainted with the Amber Museum.

On the third day of the symposium, two more plenary presentations were made. Prof. Dr. Metka Kordigel-Aberšek (University of Maribor, Slovenia) discussed science and technology literacy issues in the context of modern ICT (Figure 7). The core idea of the presentation was how to teach the younger generation how to search, evaluate, and use information on the Internet.

Figure 7

Plenary Presentation by Metka Kordigel-Aberšek



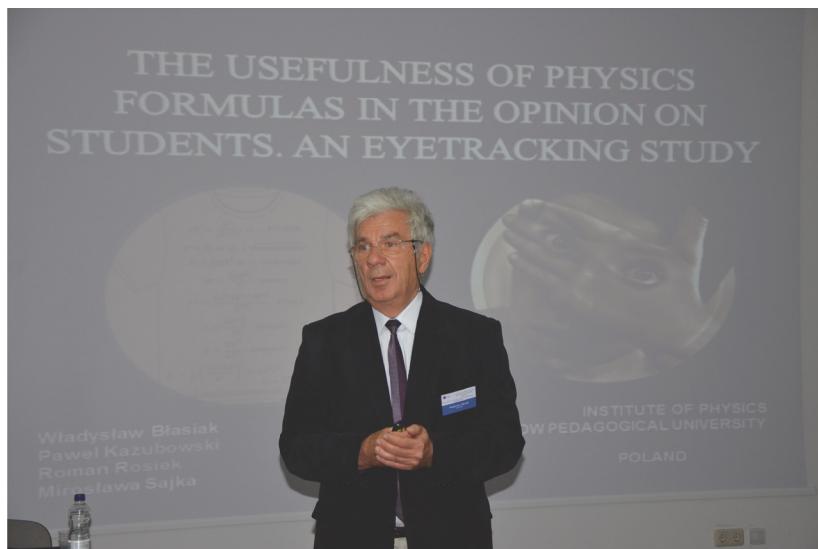
Prof. Dr. Liberato Cardellini (Marche Polytechnic University, Italy) presented the current state of science and technology education in Italy, highlighting the main issues to be addressed. In particular, he stressed the importance of teacher training in science subjects and the continuous development of the competencies of in-service teachers (Figure 8).

Figure 8

Plenary presentation by Liberato Cardellini



The symposium was also divided into two sections. The first was devoted to general issues in science and technology education, while the second dealt with the practical aspects of the education process. The range of issues covered is wide. Prof. A. Kaksis (Latvia) addressed the issues of teaching medicinal chemistry, Dr. K. Dudek (Poland) discussed the aspects of assessing students' achievements in teaching chemistry, and Prof. D. Cedere (Latvia) discussed the peculiarities of the process of science education in the development of cognitive abilities in learners. Wladyslaw Blasiak discussed the usefulness of physics formulas in the opinion of students (Figure 9). A quite interesting eye-tracking study was carried out in Poland. This study made use of new techniques allowing tracking of the eyes of the subjects during their decision-making process (Blasiak et al., 2015).

Figure 9*Presentation by Wladyslaw Blasiak*

Abdeljalil Météoui (Canada) discussed issues related to acquiring scientific and pedagogical competencies of primary pre-school teachers (Figure 10). It was highlighted that acquiring science and pedagogical competencies by primary preschool teachers is a reality (Météoui & Trudel, 2015). Another interesting presentation focused on the practice of mathematics education was given by Lukáš Vizek (Czech Republic). During the presentation, the calculation of the volume of the antiprism in the cube as a secondary mathematical problem was shown (Figure 11).

Figure 10*Presentation by Abdeljalil Météoui***Figure 11***Presentation by Lukáš Vízek*

The fourth day of the symposium was devoted to presentations on the use of ICT in science and technology education. In addition, a round table discussion was organized

during which researchers from different countries shared their insights on possible further cooperation with Šiauliai University, the organization and realization of international research, and the development of joint research projects (Figure 12).

Figure 12

Roundtable Discussion (from left): Prof. Liberato Cardellini, Prof. Dagnija Cedere, Prof. Juris Porozovs, Prof. Rita Birzina, Prof. Josef Trna.



The proceedings of the symposium were prepared and published before the symposium. The full version is freely available online at https://www.academia.edu/13101334/STATE-OF-THE-ART_AND_FUTURE_PERSPECTIVES. The edition contains 34 short papers covering various science and technology education issues (Figure 13 & 14).

Figure 13

Cover of the Symposium Proceedings



STATE-OF-THE-ART AND FUTURE PERSPECTIVES

Proceedings of the 1st International Baltic Symposium on Science and Technology Education (BalticSTE2015), Šiauliai, 15–18 June, 2015

Vincentas Lamanaukas,
Violeta Šlekiienė, & Loreta Ragulienė (Eds.)

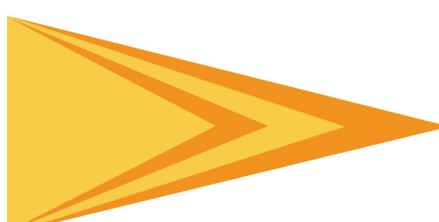


Figure 14

Cover page of the Symposium Proceedings

Vincentas Lamanaukas, Violeta Šlekiienė, & Loreta Ragulienė (Eds.)

STATE-OF-THE-ART AND FUTURE PERSPECTIVES

Proceedings of the 1st International Baltic Symposium on Science and Technology Education (BalticSTE2015), Šiauliai, 15–18 June, 2015

Reviewers:

Dr. Rita Makarskaitė-Petkevičienė
Dr. Milan Kubiatko

ISBN 978-609-95513-2-6

The authors also had the opportunity to prepare and publish full-length articles in the scientific journals *Journal of Baltic Science Education*, *Problems of Education in the 21st Century*, *Natural Science Education*, and others.

The participants had excellent opportunities not only to participate formally in the symposium. There were regular informal discussions, exchanges of contact information, sharing of experiences, finding project partners, etc. The participants got acquainted with the Faculty of Education of Šiauliai University, the activities of the Research Centre for Science Education were presented. Some of the participants visited the Hill of Crosses and the Museum of the Baltic Gods in Naisiai (Figures 15 & 16).

Figure 15

Paolo Bussotti and Vincentas Lamanauskas Symposium Participants in Naisiai in Naisiai



Figure 16

Symposium Participants in Naisiai in Naisiai



So, the first symposium is history. A more extensive presentation in English is available online at <https://www.facebook.com/media/set/?set=a.1125696737447761.1073741845.290054444345332&type=3>. As always, not everything was captured and not all interesting issues were discussed. We can only hope that the science education movement will continue and grow. The second symposium is expected to take place in Šiauliai in June 2017. Full details can be found on the Symposium website at <http://balticste.com>

SECOND SYMPOSIUM: BalticSTE2017

Natural science and technology education improvement remains actual. In the context of decreasing youth interest in natural sciences and technology, it is important to search for the ways and devices of effective motivation and interest formation. The 2nd International Baltic Symposium on Science and Technology, “BalticSTE2015”, having taken place in Siauliai, was devoted to this. Its major topic is the improvement of natural science and technology education of the young generation. The symposium was organised by the scientific methodological centre “Scientia Educologica”. The main symposium partner is Education sciences and psychology department at Siauliai University. Such kind of symposium was organised in Lithuania for the second time after the restoration of Lithuanian independence in 1990. It is worth remembering, that the first symposium on the same theme was held in 2015 in Siauliai as well.

A welcome speech for the symposium was delivered by Siauliai University science and art vice rector, dr. Ingrida Šaulienė. Musical Greeting was performed by Evaldas Vaikasas, the student of the Department of Music Pedagogy at Siauliai University. The symposium participants were also welcomed (remotely) by dr. Paolo Bussotti (Udine University, Italy). Welcome speech can be found online at: <https://www.facebook.com/ScientiaEducologica/videos/1764116330272462/>.

Scientists from various foreign countries participated in the symposium. Despite the fact, that it was the Baltic region symposium, all interested could take part in it. Speaking about the region, it is necessary to emphasize that not only inviting foreign scientists is of great importance but also showing the accumulated experience of the Baltic countries, first of all, Lithuania, Latvia and Estonia, in the natural science and technology education field. Such kind of symposiums are regularly held in Asia, Africa, South and North America, and firstly, they are for the encouragement of regional science development. Guests from Brazil, Turkey, Russia, Slovenia, Slovakia, Czechia, Italy, Latvia, Poland, Estonia, South Africa, Croatia, Bosnia and Herzegovina, Portugal, and Finland participated in this symposium.

Plenary presentation authors and presentation topics are given in Table 3.

Table 3
Information about Plenary Presentations

Author (s)	Institution, country	Presentation title
Jonas Jasaitis	Siauliai university, Lithuania	The role of scientists in formation of state strategy
Miia Rannikmae	Tartu university, Estonia	Incorporating career awareness with motivational education through science approach: two alternative foci
Raffaele Pisano	Lille University, France	On the epistemic interplay between physics and mathematics such as a dynamical framework within nos-research teaching science
Angela James	Kwazulu-Natal university, South Africa	Science education in South Africa: engaging the new generation of student teachers in service-learning for sustainable development
Agnaldo Arroio	University of Sao Paulo, Brazil	Scientific Media literacy and young generation
Andris Broks	University of Latvia, Latvia	Systems thinking: Joint philosophical and psychological basis for modern science and technology education

Professor J. Jasaitis from Šiauliai University spoke about the role of scientists in shaping the state development strategy (Figure 17).

Figure 17
Plenary Presentation by Jonas Jasaitis, Lithuania



Emphasis has been placed on scientists' role in forming state strategy. The main idea was that this is undeniably important, as their expertise and evidence-based insights are critical for addressing complex societal challenges and informing effective governance.

Professor Mii Rannikmae from the University of Tartu (Estonia) presented on incorporating career awareness with motivational education through a science approach (Figure 18).

Figure 18
Plenary Presentation by Mii Rannikmae, Estonia



According to Rannikmae, incorporating career awareness with motivational education through a science-based approach is highly important, as it can enhance students' engagement, self-efficacy, and career aspirations. Career-related education integrated into science education can make learning more relevant and engaging by connecting scientific concepts to real-world applications and careers.

Professor Raffaele Pisano discussed the epistemic interaction between physics and mathematics (Figure 19).

Figure 19

Plenary Presentation by Raffaele Pisano, France



According to Pisano, the epistemic interplay between physics and mathematics is highly relevant, especially in a dynamical framework for teaching science and fostering research. This relationship is fundamental to understanding the nature of scientific inquiry and its pedagogical implications.

The third plenary presentation was made by Professor Angela James from the University of Kwazulu-Natal (South Africa) (Figure 20).

Figure 20

Plenary Presentation by Angela James, South Africa



The topic of the presentation was science education in South Africa. The presenter stressed that engaging the new generation of student teachers in service-learning for sustainable development is highly relevant due to its transformative potential in education and its alignment with global sustainability goals. According to James, service learning (SL) integrates academic learning with community engagement, making it an effective tool for fostering awareness and action on SDGs.

The fourth plenary presentation was made by Professor Agnaldo Arroio from the University of Sao Paulo (Brazil). The presentation focused on scientific media literacy and young generation (Figure 21).

Figure 21
Plenary Presentation by Agnaldo Arroio, Brazil



The presenter pointed out that scientific media literacy is crucial for the young generation as it equips them with the skills to critically evaluate and engage with scientific information in a rapidly evolving media landscape. According to Arroio (2017), citizens who possess media literacy may be better equipped to support the fundamental human right of individuals to seek, receive, and share information and ideas, as well as to communicate and express themselves.

Professor Andris Broks gave the last plenary presentation of the symposium from the University of Latvia (Latvia). The speaker has chosen a theme that has been consistently developed further, namely systems thinking (Figure 22).

Figure 22

Plenary Presentation by Andris Broks, Latvia



The speaker addressed contemporary science and technology education's overall philosophical and psychological underpinnings. According to Broks (2016), due to the worldwide expansion of information, we must maintain our sense of direction in our day-to-day lives. Since simple professions are becoming automated and virtual robots are replacing human workers with biorobots, professional training must enhance practitioners' knowledge of a far higher theoretical level of thinking than previously.

On the first day of the symposium there were also presented ten board reports (posters). For example, dr. Violeta Šlekienė made a presentation on the accumulated experience of Lithuanian non-formal educational school of young physicists "Photon". Lithuanian education science university researchers examined pre-service primary teachers' experience organizing science lessons. Dr. Katarzyna Potyrala, Karolina Czerwiec and Renata Stasko presented an experience on using a science museum as an educational environment in natural science education (Figure 23).

Figure 23

A Team of Polish Researchers: Renata Stasko, Emanuel Studnicki, Karolina Czerwiec, Katarzyna Potyrala



Vincentas Lamanauskas, Violeta Šlekienė and Loreta Ragulienė made a presentation on international MaT²SMc project experience (<http://www.mat2smc-project.eu>).

Figure 24
Symposium Poster

2nd International Baltic Symposium on Science and Technology Education (BalticSTE2017)

**SCIENCE AND TECHNOLOGY EDUCATION:
ENGAGING THE NEW GENERATION**

**12-15 June 2017,
Siauliai, Lithuania**

KEYNOTE SPEAKERS

Prof. dr. Raffaele Pisano
CIREL, Lille 3 University, France
Title:
ON THE EPISTEMIC INTERPLAY
BETWEEN PHYSICS AND
MATHEMATICS SUCH AS A DYNAMICAL
FRAMEWORK WITHIN NOS-RESEARCH
TEACHING SCIENCE

Dr. Angela A. James
University of KwaZulu-Natal, South Africa
Title:
SCIENCE EDUCATION IN SOUTH
AFRICA: ENGAGING THE NEW
GENERATION OF STUDENT
TEACHERS IN SERVICE-LEARNING
FOR SUSTAINABLE DEVELOPMENT

Prof. dr. Andris Broks
University of Latvia, Latvia
Title:
SYSTEMS THINKING: JOINT
PHILOSOPHICAL AND
PSYCHOLOGICAL BASIS FOR MODERN
SCIENCE AND TECHNOLOGY
EDUCATION

Prof. dr. Agnaldo Arroio
University of Sao Paulo, Brazil
Title:
SCIENTIFIC MEDIA LITERACY AND
YOUNG GENERATION

Prof. dr. Miia Rannikmae
University of Tartu, Estonia
Title:
INCORPORATING CAREER
AWARENESS WITH MOTIVATIONAL
EDUCATION THROUGH SCIENCE
APPROACH: TWO ALTERNATIVE FOCI

Prof. dr. Jonas Jasaitis
Siauliai University, Lithuania
Title:
THE ROLE OF SCIENTISTS IN
FORMATION OF STATE STRATEGY

Symposium Website:
<http://balticste.com/>

E-mail:
balticste@gmail.com

Symposium Organizers

 **SIAULIAI
UNIVERSITY**

 **EDU TEA
SOCIETY**

On the first day of the symposium work in sections was organised. The researchers from Brazil, South Africa, Poland, Latvia made presentations. Also, a remote video presentation was made from South Korea. The topic of the report is “Influence of nanotechnology related SSI program on competencies of high school students in Korea” (by Hae-Ae Seo, Hye-Sook Lee, Soonok Kim) (Figure 25).

Figure 25

Remote Video Presentation by South Korea Team

Influence of nanotechnology related SSI program on competencies of high school students in Korea



2ND INTERNATIONAL BALTIC SYMPOSIUM ON
SCIENCE AND TECHNOLOGY EDUCATION

June 12-15, 2017, Šiauliai, Lithuania

Presented at 12:15~12:30, June 15, Thursday

Hae-Ae Seo, Hye-Sook Lee, & Soonok Kim

Pusan National University, Korea



The presenters emphasized that there is more to competency than just knowledge and abilities. It entails the capacity to handle intricate demands by utilizing and mobilizing psychosocial resources, such as abilities and dispositions, within a specific setting. In addition, divergent interests and values among people and interest groups frequently lead to arguments and conflicts when evaluating the advantages of using a new technological product from consumers' perspective. To find answers in this situation, individuals must possess the necessary skills, dispositions, and scientific knowledge (Seo et al., 2017).

The second day of the symposium was devoted to the trip. The theme of the trip was – “Historical aspects of natural science and technology education”. The participants of the symposium visited and got acquainted with some North Lithuanian places of interest (Figure 26 & 27). They visited Joniškis basketball museum (<http://joniskiokrepsonoimuziejus.lt>) and also Akmenė region museum (<http://www.akmenesmuziejus.lt/en>). The symposium participants were extremely interested in a wonderful butterfly collection exhibited at the museum, and also in the carried-out project “Butterfly home”, one of the main purposes of which is to go to educational expeditions.

The symposium participants also visited the Pharmacy Museum in Vieksnai (<http://mazeikiutvic.lt/en/the-pharmacy-museum-in-vieksnai>). Pharmacy exposition,

the first half of the 20th century intellectual's everyday life exposition is displayed at the museum. An extraordinary part of the pharmacy museum is – a restored pharmacist's herb garden, in which herb and spice plants are grown, educational practical activities are carried out. During these activities, one can not only look around the garden but also get acquainted with the features of the plants grown in it (Figure 28).

Figure 26

Symposium Participants in Joniškis Basketball Museum



Figure 27

Observing Butterflies, Grown in Akmenė Region Museum



Symposium participants also visited Gruzdžiai black ceramics workshops, some of them practically tried themselves the subtleties of clay processing. The participants had a perfect chance to get acquainted in detail with ceramic pottery production, they could also buy some things for themselves. A very attractive place to visit was the Jurakalnis observation tower in Papilė (Figure 29). A spectacular scenery opens from that tower to Venta countryside reserve, Papilė town, Daubiškis village, Venta river curves and other. The form of the tower itself is very impressive, reminding a blossom of a flower. Besides, the tower is made of wooden and metal constructions.

Figure 28

Herbal Tea Drinking Ceremony at the Pharmacy Museum in Viekšnai



Figure 29

Climbing the Jurakalnis Observation Tower Near Papilė



On the third day of the symposium, two more plenary presentations were made. Dr. Angela James (Kwazulu-Natal University, South Africa) talked about natural science and technology actualities in her country. An extremely big attention was devoted to sustainable development questions, an experience was shared on work with local

communities. Prof. dr. Agnaldo Arroio (University of São Paulo, Brazil) examined scientific media literacy and young generation actualities. He also shared his work experience in Mozambique.

Table 4

The List of Workshop Presentations

Workshop (1)	Workshop (2)
Marcus Vinícius Pereira, Agnaldo Arroio. Analysis of science videos produced by Brazilian Ministry of Education (Brazil)	Uladzimir Slabin. Verkhovsky Eponyms in the Epoch of Educational Ethnocentrism (USA, <i>video presentation</i>)
Alvin U. Ugwu. Locating evidences of education for sustainable development in Sub-Saharan African science and technology education curricular: a comparative analysis of Nigerian and South Africa (South Africa)	Suriya Gilmanshina, Aygul Gayfullina, Iskander Gilmanshin. The formation of the environmentally directed thinking as the necessary quality of personality in modern conditions (Russia)
Pavels Pestovs, Dace Namsone. National level test in science in Latvia for assessing how students explain phenomena scientifically (Latvia)	Katrin Vaino, Toomas Vaino, & Mira Rannikmäe. Students' conceptions of the nature of technology: development of a reliable instrument (Estonia)
Renata Stasko, Karolina Czerwiec, Katarzyna Potyrala, Emanuel Studnicki, Anna Michniewska. Education in the area of new media on the example of YouTube and interdisciplinary workshops (Poland)	Vyacheslav Kazarenkov, Saulius Mickevičius. The significance of self-education in professional training and personal development of future specialist at university (Russia, Lithuania)
Solange W. Locatelli, Paulo H. Gomes, Agnaldo Arroio. The influence of chemical language in the reworking of basic concepts in electrochemistry (Brazil)	Hae-Ae Seo, Hye-Sook Lee, Soonok Kim. Influence of nanotechnology related SSI program on competencies of high school students in Korea (South Korea)
	Vyacheslav Kazarenkov, Tatyana Kazarenkova. Fostering skills of cross-cultural communication within university education (Russia)

Symposium work took place in two sections as well. The first one was for general natural science and technology education questions, in the second one – practical education process matters were discussed (Table 4 & 5). The spectrum of the questions discussed is rather wide. Dr. Elena Vasilevskaya (Republic of Belarus) examined university natural science education problems, shared her personal experience, prof. dr. D. Cedere (Latvia) talked about students' interest in natural science subjects and mathematics in Latvian and Lithuanian comprehensive schools. Comparative research results were presented.

Table 5
Presentations in Sections

Section 1 General S&T Education Issues	Section 2 S&T Education Approaches and Praxis
Ineta Helmane, Dagnija Čēdere, Vilija Targamadze, Inese Jurgena. Students' interest in the science subjects and mathematics in schools of Latvia and Lithuania: a comparative study (Latvia, Lithuania)	Boris Aberšek, Kosta Dolenc, Andrej Flogie. Research based learning and proprioception (Slovenia)
Elena Vasilevskaya. University natural science education: current state and modern trends (Republic of Belarus)	Martin Bílek, Jiri Rychtera, Katerina Chroustová. Identification of key and critical points in early chemistry curriculum in Czech Republic (Czech Republic)
Cagla Bulut, Bülent Cavas, Kadir Demir. A reflection of preservice science teachers' views of open access dimension of responsible research and innovation (Turkey, USA)	Liberato Cardellini. Deliberate practice: how to teach problem solving in a meaningful way (Italy)
Rita Birzina, Dagnija Cedere, Liva Petersone. The first year students' adaptation to natural science studies in higher education (Latvia)	Rafael Doležal, Natálie Karásková, Nadezhda V. Maltsevskaya, Karel Kolář. Supporting conceptual learning in organic chemistry through semi-empirical molecular modeling: heuristics of diels-alder [4+2] cycloadditions for preparation of potential TLR4 modulators (Czech Republic, Russia)
Loreta Juškaitė. Comparison of the national diagnostic paper-based and online tests (Latvia)	Metka Kordigel Aberšek. Writing versus typing in the biology classroom: a case study in Slovenia (Slovenia)
Eva Kralova. Motivation and attitudes of medical students towards teaching and learning natural sciences (Slovakia)	Antti Rissanen, Kalle Saastamoinen. Challenges in assessment and guidance in study group based learning (Finland)
Vincentas Lamanauskas, Dalia Augienė. Scientific research activity of students' pre-service teachers at university: comparative analysis of understanding, interest and career aspects (Lithuania)	Mónica Baptista. Collaboration between physics and chemistry teachers and expert: a contribution to teachers' professional development (Portugal)
Alex Wirth, Boris Aberšek. Discipline in schools: some actual issues (Slovenia)	Lukáš Richterek, František Látal. Various kinds of problems in an electricity and magnetism assessment within an introductory physics course for chemistry majors (Czech Republic)
Şule Bayraktar, Zeynep Kuvvet. Preschool children's ideas about living things (Turkey)	Oxana N. Ryzhova, Elizaveta A. Belevtsova, Nikolay E. Kuz'menko. Chemistry and mathematics: mathematical content of chemical tasks (Russia)
Anna Klim-Klimaszewska, Stanisława Nazaruk. Implementation of geometrical concepts in kindergarten (Poland)	Teresa Conceição, Mónica Baptista, João Pedro da Ponte. Lesson study as a professional development process of preservice physics and chemistry teachers (Portugal)
Bülent Cavas, Cagla Bulut. Students' perceptions toward science course and inquiry based science education (IBSE) implementation in schools study earthquakes (SSE) Project (Turkey)	
Meliha Zejnilagić-Hajrić, Adel Polutak, Ines Nuić. Group work in evaluation of primary school students' knowledge about carbohydrates (Bosnia and Herzegovina)	

The fourth symposium day was for presentations, during which ICT usage in natural science and technology education process and other actual this sphere questions were discussed (Figure 30 & 31). Prof. dr. Andris Broks (Latvia) made an interactive plenary presentation on the topic “Systems thinking: Joint philosophical and psychological basis for modern science and technology education”. Later, a discussion took place on the mentioned topic, which was moderated by prof. Vincentas Lamanauskas. During the

time of discussion, R. Pisano (Italy), A. James (South Africa), J. Holbrook (Estonia), B. Cavas (Turkey), B. Aberšek (Slovenia) presented short reviews.

Figure 30

Presentation by Jack Holbrook, Estonia



Figure 31

Informal discussions (Andris Broks and Lukaš Richterek)



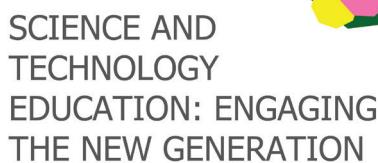
During the whole symposium, various country researchers shared their insights on possible further collaboration with Šiauliai university, international research organising and carrying out, common science project preparation (Figure 32).

Figure 32
Symposium Participant Photo



Before the symposium, an article collection was prepared and issued. The full version of the publication is very freely available on the internet at https://www.academia.edu/33349325/SCIENCE_AND TECHNOLOGY EDUCATION ENGAGING THE NEW GENERATION. In the publication, a total of 35 short papers are published, in which various natural science and technology education problems are discussed (Figure 33 & 34).

Figure 33
Symposium Publication Cover



Proceedings of the 2nd International
Baltic Symposium on Science and
Technology Education (BalticSTE2017),
Šiauliai, 12–15 June, 2017

Vincentas Lamanauskas (Ed.)

Figure 34
Symposium Publication Title Page

**SCIENCE AND TECHNOLOGY
EDUCATION: ENGAGING THE NEW
GENERATION**

Proceedings of the 2nd International Baltic Symposium on Science
and Technology Education (BalticSTE2017),
Šiauliai, 12–15 June, 2017

Reviewers:

Dr. Rita Makarskaitė-Petkevičienė
Dr. Milan Kubatko

ISBN 978-609-95513-4-0

The authors also had the possibility to prepare and publicise full text articles in the scientific journals “Journal of Baltic Science Education”, “Problems of Education in the 21st Century”, “Gamtamokslinis ugdymas / Natural Science Education”, and others.

Symposium participants had perfect possibilities not only to formally participate in the symposium. Constant non-formal discussions were going on; contact information was exchanged, the experience was shared, project partners were searched, and so on. Symposium guests got acquainted with Šiauliai University's Educational sciences faculty; the natural science education research centre activity was introduced. Some of the guests visited Crosses Hill (Figure 35), and also got acquainted with the Baltic god museum in Naisiai village (Figure 36).

Figure 36

*Agnaldo Arroio, Vaidas Lamanauskas, Angela James and Alvin Uchenna Ugwu
Angela James in Naisiai*



Figure 35



So, the second symposium is also already a history. A wider presentation in English one can find on the internet at: <https://www.facebook.com/media/set/?set=a.1771904166160345.1073741888.290054444345332&type=3>. As always, not everything was fixated, and not all interesting questions were discussed. One can hope that the natural science education movement will continue and develop. It is expected that the third symposium will take place in Šiauliai in June 2019. Detailed information is given in the symposium internet cafe at: <http://balticste.com>

THIRD SYMPOSIUM: BalticSTE2019

Two years after the second international BalticSTE symposium passed very quickly, and here the third international science symposium is already a history too. On the 17th -20th of June this year, the 3rd International Baltic Symposium on Science and Technology Education, BalticSTE2019, took place in Šiauliai. The topic of the Symposium was “Science and Technology Education: Current Challenges and Possible Solutions”. More than 50 scientists from 20 countries participated in the symposium. Comparing with the symposium, which took place in 2017, the geographical distribution of the participants is significantly wider. Ukrainian, Serbian, Romanian, Malaysian researchers participated in the symposium for the first time.

Natural science education requires constant researchers' attention in the rapidly changing technological age, new educational methodologies, and innovative educational approaches. The symposium reporters' analysed topic spectrum is wide, from global warming and climate change to philosophical methodological and education evaluation questions.

One of this international symposium ideas is to show that Baltic region countries also actively participate in natural science and technology education research, especially in the STEAM context. The second idea is that Baltic countries, as well as other small regions of the world, need corresponding close communication and cooperation.

The symposium was organised by the scientific methodological centre “Scientia Educologica”. The main symposium partner was Šiauliai University Institute of Education. Such kind of symposium was organised in Lithuania for the third time after the restoration of Lithuanian independence in 1990.

A welcome speech for the symposium was delivered by Šiauliai University acting vice-rector for studies dr. Renata Bilbokaitė. Musical Greeting was performed by the Šiauliai nursery-school kindergarten “Žirniukas” children's group (leader, artistic education teacher Regina Varpučianskiėnė). The music literature programme “Native country talks” was prepared and performed. The symposium participants were also welcomed (remotely) by the IOSTE chairperson, Dr. Agnaldo Arroio (University of São Paulo, Brazil). The welcome speech can be found online at: <https://www.youtube.com/watch?v=EOKu58zhL6Y&feature=youtu.be>. The President of the Lithuanian Scientific Society, Prof. Jonas Jasaitis, greeted the participants too and wished them meaningful discussions.

As it was mentioned, researchers from 20 countries participated in the symposium work. It is very pleasing that researchers from such remote countries as Brazil, Taiwan, Malaysia, Canada, South Korea, South Africa participated. This is a very meaningful intercontinental link. In addition to these countries, the researchers from the Czech Republic, Estonia, Finland, Latvia, Poland, Portugal, Belarus, Serbia, Romania, Russia, Slovakia, Slovenia, and Ukraine also participated.

Traditionally, six main (plenary) reports were planned in the symposium. Due to the objective reasons, Prof. Małgorzata Nodzynska from Poland could not take part in the symposium. Prof. Boris Aberšek from Slovenia substituted for her. Plenary report subjects comprised a very wide spectrum of natural science and technology education

problems. It was discussed about Engineering pedagogy, metacognitive strategies in science and technology education were analysed, smart and intelligent learning environments were talked about, etc.

Plenary presentation authors, presentation topics are given in Table 6.

Table 6
Information about Plenary Presentations

Author (s)	Institution, country	Presentation title
Tiia Rüütmann	Tallinn University of Technology, Estonia	Engineering pedagogy science as the contemporary basis of effective teaching science and technology
Dusica Rodić	University of Novi Sad, Republic of Serbia	Combined measures of students' success: Recent trends and developments in science education research
Boris Aberšek	University of Maribor, Slovenia	Smart and intelligent learning environments and ethical issues
Solange Locatelli	Federal University of ABC, Brazil	Metacognitive strategies in science and technology education: Limits and possibilities
Todar Lakhvich	Belarusian State Medical University, Republic of Belarus	One chemistry – two meanings. Science and education: Comparative analysis of the roles, presentation and applications
Andris Broks	University of Latvia, Latvia	Changes all around us and within science education

Professor Tiia Rüütmann from Tallinn University of Technology (Estonia) gave an interesting and useful presentation (Figure 36). It is obvious that engineering pedagogy science plays a crucial role in contemporary education, particularly in the fields of science, technology, engineering, and mathematics (STEM).

Figure 36
Plenary Presentation by Tiia Ruutmann, Estonia



According to the presenter, engineering education is a large system, and it is almost impossible to predict its behaviour over far too distant future since the system parameters show a high rate of change (Kipper & Rüütmann, 2010). The presenter emphasized that by focusing on real-world applications, engineering pedagogy nurtures essential skills such as resilience, creativity, and collaboration.

The next plenary presentation focused on recent trends and developments in science education research. This presentation was made by Dr Dušica Rodić from the University of Novi Sad (Republic of Serbia). According to Rodić (2019), research on improving the methods and procedures of evaluating educational efficiency is therefore essential, as it is a significant topic of study in science education (Figure 37).

Figure 37

Plenary Presentation by Dušica Rodić, Republic of Serbia



The presenter emphasized that using the eye tracking technique as a very effective instrument that not only offers the advantages mentioned above but also crucial information about students' misconceptions should be the subject of future research.

The third plenary presentation was given by Prof. Boris Aberšek from the University of Maribor (Slovenia). The issues raised by the report are highly topical (Figure 38). Smart and intelligent learning environments (SLEs) are topical due to their transformative impact on education, but they also raise several ethical issues that need to be addressed.

Figure 38

Plenary Presentation by Boris Aberšek, Slovenia



According to the presenter, SLEs offer individualized learning experiences by utilizing cutting-edge technologies like artificial intelligence (AI), which raises student engagement and improves learning results. Aberšek underlined that SLEs provide learning flexibility by enabling students to access learning materials at any time and from any location.

The next plenary presentation was given by Dr. Solange Locatelli (Figure 39) from the Federal University of ABC (Brazil). It makes sense when a symposium brings together not only the scientific themes covered, but also geographical continents.

Figure 39

Plenary Presentation by Solange Locatelli, Brazil



It is clear that with the use of metacognitive techniques, students can choose efficient methods for understanding difficult scientific ideas and become more conscious of their own learning processes. According to Locatelli et al. (2010), although metacognition is frequently described in the literature as "thinking about one's own thinking," we must consider that its nature is far more intricate and encompasses a variety of factors.

Dr. Todar Lakhvich from Belarusian State Medical University (Republic of Belarus) discussed about one chemistry – two meanings (Figure 40).

Figure 40

Plenary Presentation by Todar Lakhvich, Belarus



The presenter emphasized that the phrase "One chemistry – two meanings" highlights the dual roles of chemistry as both a scientific discipline and an educational field. One may consider chemistry the foundation of the scientific and spiritual paradigms that conflict. The cultural perception of chemistry, how it shapes the world, and how chemists organize, investigate, and produce their labs, tools, materials, texts, research objects, and, ultimately, results in accordance with aesthetic standards are all included in the meaning of aesthetic analysis of chemistry (Lakhvich, 2019).

The last plenary presentation of the symposium was traditionally given by Professor Andris Broks from the University of Latvia (Latvia). The main idea of the presentation was the changes around us and in the natural sciences (Figure 41).

Figure 41

Plenary Presentation by Andris Broks, Latvia



High levels of internal and external diversity, as well as the rapidity of accompanying changes, are characteristics of contemporary challenges, which are complicated. We must begin today by shifting the way our world of thoughts is now organized and gaining a general sense of direction for our contemporary daily activities (Broks, 2019).

On the first day of the symposium, poster presentations also took place (Table 7). On the whole, 6 poster reports were presented: two by Lithuanian researchers, and one from each Poland, Brazil, Taiwan, and Belarus researchers. For example, Dr. Violeta Šlekienė made a presentation on the usage of STEAM program in developing and improving of students' experimental skills. Małgorzata Bartoszewicz and Grzegorz Krzyśko from Poland presented an experience on popularization of chemistry in non-formal education. Poster presentation made by Elena Vasilevskaya, Svyatlana Vashchanka, and Natalia Boboriko was about the rating score system and academic achievements of students. The researchers presented an experience of the Chemistry Faculty of the Belarusian State University, Republic of Belarus.

Table 7*The List of Presentations in Sections 1 and 2, and Poster Presentations*

Section 1 General S&T Education Issues	Section 2 S&T Education Approaches and Praxis
Mária Babinčáková, Mária Ganajová, Ivana Sotáková, Veronika Jurková. The implementation of formative assessment into chemistry education at secondary school (Czech Republic, Slovak Republic)	Dace Bertule, Girts Burgmanis, Dace Namsone. Piloting multidisciplinary fieldwork project "Forest" (Latvia)
Nadia Venskuvienė. Higher order thinking task and question application in the world cognition lessons in primary forms (Lithuania)	Ching-Ching Cheng, Kuohung Huang. Computer programming learning activities in preschools: an exploratory study (Taiwan)
Ilva Cinite, Girts Barinovs. Measuring knowledge growth for individual bachelor students at science courses of university of Latvia (Latvia)	Renata Holubová, Anna Krčmářová, Lukáš Richterek, Jan Říha. Analysis of some selected force concept inventory tasks using eye-tracking and correlation with scientific reasoning skills (Czech Republic)
Teresa Conceição, Mónica Baptista, João Pedro da Ponte. Lesson study as a process for developing the pedagogical content knowledge of pre-service physics and chemistry teachers (Portugal)	Marie Hubálovská, Štěpán Hubálovský, Pavel Krejčí. The construction activity as a method of polytechnic and science learning (Czech Republic)
Pavels Pestovs, Ilze Saleniece, Dace Namsone. Science large-scale assessment alignment to the revised science curriculum (Latvia)	Loreta Juškaite. Data mining in education: online testing in Latvian schools (Latvia)
	Virginija Šidlauskiene. Subtle gender bias in academia (Lithuania)
	Anna Klim-Klimaszewska. Magnet and its application. Physics education in kindergarten (Poland)

Poster Presentations

Małgorzat Bartoszewicz, Grzegorz Krzyśko. Popularization of chemistry in non-formal education (Poland)
Rita Makarskaitė-Petkevičienė. Students' natural science contest: task analysis in the aspect of knowledge and understanding (Lithuania)
Violeta Šlekienė. The usage of STEAM program in developing and improving of students' experimental skills (Lithuania)
Ariane Baffa Lourenço, Salete Linhares Queiroz, Armin Weinberger. Pre-service chemistry teachers' beliefs about argumentation and argumentative practice (Brazil, Germany)
Tzu-Yang Huang, Chih-Hsiung Ku. The public understanding of emerging technology in East Taiwan area: an example of nanotechnology (Taiwan)
Elena Vasilevskaya, Svetlana Vashchanka, Natalia Boboriko. Rating score system and academic achievements of students: Experience of the Chemistry Faculty of the Belarusian State University (Republic of Belarus)

Figure 42
Symposium Poster



**3rd International Baltic Symposium on Science and Technology Education
(BalticSTE2019)**

SCIENCE AND TECHNOLOGY EDUCATION: CURRENT CHALLENGES AND POSSIBLE SOLUTIONS

17-20 June 2019, Siauliai, Lithuania

KEYNOTE SPEAKERS



Dr. Dusica Rodic
University of Novi Sad, Republic of Serbia
Title:
COMBINED MEASURES OF STUDENTS' SUCCESS: RECENT TRENDS AND DEVELOPMENTS IN SCIENCE EDUCATION RESEARCH



Dr. Todor Lakhvich
Belarusian State Medical University, Republic of Belarus
Title:
ONE CHEMISTRY - TWO MEANINGS. SCIENCE AND EDUCATION: COMPARATIVE ANALYSIS OF THE ROLES, PRESENTATION AND APPLICATIONS



Prof. Dr. Małgorzata Nodzyńska
Pedagogical University of Cracow, Poland
Title:
ANALYSIS OF PIAGET'S THEORY INFLUENCE ON THE TEACHING OF SCIENCE



Dr. Tiia Rüütmann
Tallinn University of Technology, Estonia
Title:
ENGINEERING PEDAGOGY SCIENCE AS THE CONTEMPORARY BASIS OF EFFECTIVE TEACHING SCIENCE AND TECHNOLOGY



Prof. Dr. Andris Broks
University of Latvia, Latvia
Title:
CHANGES ALL AROUND US AND WITHIN SCIENCE EDUCATION



Prof. Dr. Solange Locatelli
Federal University of ABC, Brazil
Title:
METACOGNITIVE STRATEGIES IN SCIENCE AND TECHNOLOGY EDUCATION: LIMITS AND POSSIBILITIES

Symposium Website:
<http://balticste.com/>

E-mail:
balticste@gmail.com

Supporting Journals

Journal of Baltic Science Education
Problems of Education in the 21st Century
Gamtamokslinis ugdymas / Natural Science Education
Svietimas: politika, vadyba, kokybė / Education Policy, Management and Quality

Symposium Organizers



On the first day of the symposium, work in sections was also organised (Table 8). Traditionally, the topic of the first section was oriented to General Science and Technology Education issues. 5 reports were made here (Lithuanian, Czech Republic, Slovakian, Latvian, Portuguese researchers). The second section topic was oriented to Science and Technology Approaches and Praxis. In this section, 7 reports were made (Polish, Lithuanian, Latvian, Czech Republic, and Taiwanese researchers).

Table 8

The List of Presentations in Sections 3 and 4

Section 3 <i>General S&T Education Issues</i>	Section 4 <i>S&T Education Approaches and Praxis</i>
Saša A. Horvat, Dušica D. Rodić, Tamara N. Rončević, Mirjana D. Segedinac. Validation of method for the assessment of cognitive complexity of chemical technology problem tasks (Republic of Serbia)	Karel Kolar, Martin Bilek, Katerina Chroustova, Jiri Rychtera, Veronika Machkova. Calcium cycle in chemistry teaching at the lower secondary school (Czech Republic)
Dagnija Cedere, Rita Birzina, Tamara Pigozne, Elena Vasilevskaya. How to make learning in STEM meaningful for the millennium generation (Latvia, Republic of Belarus)	Metka Kordigel Aberšek, Zvonka Cencel, Boris Aberšek, Andrej Flogie. Metacognitive model for developing science, technology and engineering functional literacy (Slovenia)
Liliana Mătă, Ro'xana Maria Ghiatău. Teachers' attitudes towards unethical use of mobile technologies in higher education (Romania)	Irina Kryazheva. Physical component of tasks in chemistry (Russian Federation)
Liliana Mătă, Ionuț Stoica. Measuring attitudes of biology teachers towards internet (Romania)	Tetiana Mazurok, Volodymyr Chernykh. Knowledge-based approach to adaptive selection of equipment for teaching robotics (Ukraine)
Msizi Mbali, Angela James. A tutor's personal and professional experiences of tutoring in a science teacher education module (South Africa)	Stanisława K. Nazaruk, Joanna Marchel. Effectiveness in the development and acquisition of mathematical skills in children in rural and urban preschools (Poland)
	Mónica Baptista, Iva Martins, Teresa Conceição. Multiple representations in development of students' cognitive structures about the saponification reaction (Portugal)

The second day of the symposium was devoted to the cognitive trip. The participants of the symposium visited and got acquainted with some of Central Lithuania's places of interest. The main route was more than 240 km: Šiauliai – Šeduva – Baisogala – Krekenava – Kėdainiai – Dotnuva – Radviliškis – Šiauliai.

First of all, the symposium participants visited the Directorate of Krekenava Regional Park (Figure 43). Krekenava Regional Park was founded in 1992 in order to preserve the landscape of the mid Nevezis river valley, its natural ecosystem and cultural heritage values, to ensure their management and rational use (<http://krpd.am.lt/en/VI/index.php#a/98>). The acquaintance was made with the Visitors' Centre interactive exposition, and a 30 m observation tower was climbed near the Visitors' Centre, which reveals a wonderful view of Nevezis Valley, old hoof-shaped riverbeds, lakelets, and Krekenava town.

Figure 43

Symposium participants in the Directorate At the Bison Paddock of Pašiliai of Krekenava Regional Park

**Figure 44**

At the Bison Paddock of Pašiliai



Next stop was at the Bison Paddock of Pašiliai (Figure 44), which is one of the most visited and one of the most impressive places in the region of Panevėžys, where you can see the largest European wild animals - Lithuanian aurochs (<https://www.explorebaltics.eu/sightseeing-places/pasiliai-bison-paddock/>). Symposium participants had a unique opportunity to see aurochs up close. According to the aurochs' paddock workers, at this time, 24 aurochs live in the paddock, while in the wild their population reaches more than 200. Most of the participants saw aurochs for the first time. Also, they got acquainted with the ecological-cognitive aurochs' paddock path.

Figure 45

Visiting Kedainiai Old Town

**Figure 46**

Visiting Artificial Gypsum Mountains



Having visited the aurochs' paddock, symposium participants went to Kedainiai (Figure 45). Kėdainiai is a town located in the very centre of Lithuania. The officially established geographical centre of Lithuania is only a few kilometres away. In other words, Kėdainiai is the town of six nations and confessions (<http://www.kedainiutvic.lt/tourism/en/>). The participants looked around the old town of Kėdainiai, also visited a multicultural centre, and the Mausoleum of Dukes Radvilas (<http://www.kedainiutvic.lt/tourism/en/objects/evangelical-reformed-church-and-mausoleum-of-dukes-radvilas>). A Traditional handicraft centre was also visited. This is the so-called Arnet's House, which is a material heritage of the Scottish community that lived in Kėdainiai in the 17th-18th centuries.

A visit to Kėdainiai was wreathed by a visit to a chemical fertilizer plant, "EuroChem Lifosa" (<https://www.lifosa.com/en>). Here, the visitors got acquainted with the plant's production processes, to tell the truth, using the plant's model and the exhibits from the

museum. The basic product manufactured at AB "Lifosa" is the nitrogen-phosphorus fertilizer Diammonium Phosphate (DAP), the process of which requires phosphoric acid and sulphuric acid, which are also produced at the Company. The participants could have a walk in the "artificial mountains", which are made of phosphogypsum (Figure 46).

After the visit to the plant, the participants visited a snack bar which was located in Kėdainiai suburb, in which a tasting programme "Let's Create Traditions Together" took place. Symposium participants could taste 5 types of handmade dumplings, made of the highest quality products.

On the third day of the symposium, two more plenary presentations were made. Dr. Solange Locatelli (Federal University of ABAC, Brazil) talked about metacognitive strategies in science and technology education. The second plenary report of that day was made in the afternoon. Dr. Todar Lakhvich made a presentation on the topic "One chemistry – two meanings. Science and education".

Symposium work took place in two sections as well (Table 9). The first one was for general natural science and technology education questions, and in the second one, practical education process matters were discussed. In general, 23 scientific reports were made in two sections.

Table 9

The List of Presentations in Sections 5 and 6

Section 5 <i>General S&T Education Issues</i>	Section 6 <i>S&T Education Approaches and Praxis</i>
Giovanni Scataglia Botelho Paz, Solange W. Locatelli. Metacognitive incidents manifested by students of youth and adult education in an investigative activity (Brazil)	Kalle Saastamoinen, Antti Rissanen. Teaching systems that can mimic different teaching-learning environments (Finland)
Lukáš Richterek, Jan Říha. European augmented reality training needs (Czech Republic)	Timur Sadykov, Hana Čtrnáctová. The students' opinions toward interactive lectures (Czech Republic)
Antti Rissanen, Kalle Saastamoinen. Assessment in cadets' technology course (Finland)	Ivana Sotáková, Mária Ganajová, Mária Babinčáková. The effectiveness of implementing inquiry activities into the teaching process in the phase of revising and deepening the learning content (Slovak Republic)
Hae-Ae Seo, Jae-Ho Sim. Individual behaviors as motivation, task commitment, and leadership exhibited by science gifted students at science gifted education center and its implications for differentiated instruction (Republic of Korea)	Louis Trudel, Abdeljalil Métiouli. Guidelines in the elaboration of a teaching sequence of kinematics according to a historical approach (Canada)
Youngjoon Shin, Hae-Ae Seo, Jun-Euy Hong. Development of an assessment tool for positive experiences about science (PES) (Republic of Korea)	Louis Trudel, Abdeljalil Métiouli. High school students' models of relative motion in physics (Canada)
Sergei Teleshov, Elena Teleshova. The international year of the periodic table: an overview of events before and after the creation of the periodic table (Russian Federation)	Tamara N. Rončević, Željka Đ. Ćuk, Dušica D. Rodić, Mirjana D. Segedinac, Saša A. Horvat. Students' abilities of reading images in general chemistry: the case of realistic, conventional and hybrid images (Republic of Serbia)

On the fourth symposium day, an interactive plenary report on the topic "Changes all around us and within science education" took place, which was made by Prof. Andris Broks (Latvian University, Latvia). In the interactive discussion, the colleagues Dr.

Tamara Rončević (Republic of Serbia), Dr. Angela James (South Africa), Dr. Kuohung-Huang (Taiwan), Dr. Hae-Ae Seo (South Korea) (Figure 47), and Dr. Louis Trudel (Canada) helped the main reporter (Figure 48).

Figure 47

Interactive speech by Hae-Ae Seo, South Korea



Figure 48

Interactive speech by Louis Trudel, Canada



The interactive discussion was particularly meaningful as it provided a deeper insight into current issues in science and technology education.

After an interactive discussion, section work also took place, in which 5 reports were made (Table 10).

Table 10*The List of Presentations in Section 7*

Section 7
S&T Education Challenges and Insights

Martin Bilek, Katerina Chroustova, Jiri Rychtera, Veronika Machkova, Karel Kolar, Jitka Štrofova, Radovan Sloup, Milan Šmidl, Iveta Bartova. Teachers' view on the lower secondary chemistry curriculum in the Czech Republic (Czech Republic)

Lay Yoon Fah, Ng Khar Thoe, Khoo Chwee Hoon, Chan Sane Hwui. Examining the psychometric properties of a Malaysian relevance of science education (MROSE) questionnaire using partial least squares structural equation modeling (PLS-SEM) (Malaysia)

Thuthukile Jita, Loyiso C. Jita. A descriptive analysis of preservice teachers' opportunities to learn to teach science using ICTS in South Africa (South Africa)

Vincentas Lamanauskas, Dalia Augienė. Primary school fourth grade students' ecological attitude diagnostics (Lithuania)

Małgorzata Nodzynska. Analysis of Piaget's theory influence on the teaching of science (Poland)

During the whole symposium, researchers from various countries shared their insights on possible further collaboration (Figure 49).

Figure 49*Symposium Participant Photo*

Before the symposium, an article collection was prepared and issued. The full version of the publication is very freely available on the internet at https://www.researchgate.net/publication/333929730_Science_and_technology_education_Current_challenges_and_possible_solutions_Proceedings_of_the_3rd_International_Baltic_Symposium_on_Science_and_Technology_Education_BalticSTE2019. In the publication, a total of 45 short papers are published, in which various natural science and technology education problems are discussed (Figure 50 & 51).

Figure 50
Symposium Publication Cover



Figure 51
Symposium Publication Title Page

Vincentas Lamanauskas (Ed.)

SCIENCE AND TECHNOLOGY EDUCATION: CURRENT CHALLENGES AND POSSIBLE SOLUTIONS

Proceedings of the 3rd International Baltic Symposium on Science and Technology Education (BalticSTE2019), Šiauliai, 17–20 June, 2019

ISBN 978-609-95513-6-4 /Print/, ISBN 978-609-95513-5-7 /Online/

All articles of this symposium proceedings are indexed in the Academic Resource Index (ResearchBib)

The authors also had the possibility to prepare and publicise full text articles in scientific journals “Journal of Baltic Science Education”, “Problems of Education in the 21st Century”, “Gamtamokslinis ugdymas / Natural Science Education” and others.

It is important that during the symposium the participants not only present their research, but also communicate, discuss, and share experiences in a non-formal way. On the other hand, foreign guests visited various Lithuanian places. It was a perfect opportunity to introduce the country. Symposium, as a science event, forms possibilities to broaden academic outlook. What is more, the participants individually got acquainted with various places of interest in Šiauliai city and its countryside, e.g., the Hill of Crosses, the museum of Baltic gods and other (Figure 52 & 53).

Figure 52

Dušica Rodić, Tamara N. Rončević, Saša A. Rita Birzina, Dagnija Cedere in Krekenava Regional park Visitors Center Horvat in Naisiai

**Figure 53**

Rita Birzina, Dagnija Cedere in Krekenava Regional park Visitors Center



So, the third symposium is also already a history. The event attracted over 50 scholars from 20 countries, including first-time participants from Ukraine, Serbia, Romania, and Malaysia, marking a significant expansion in its international reach. The symposium featured six plenary sessions addressing a broad spectrum of topics, such as engineering pedagogy, metacognitive strategies, smart learning environments, and ethical considerations in science education. Notable speakers included Dr. Tiia Rüütmann (Estonia), Dr. Dušica Rodić (Serbia), Prof. Boris Aberšek (Slovenia), and Prof. Andris Broks (Latvia). In addition to oral presentations and poster sessions, the symposium provided opportunities for informal networking and cultural exchange. Participants engaged in a cognitive tour exploring central Lithuania, visiting sites such as Krekenava Regional Park, the Pašiliai Bison Paddock, and the historic town of Kėdainiai. BalticSTE2019 not only facilitated scholarly discourse but also fostered international collaboration, underscoring the Baltic region's active role in advancing science and technology education.

It goes without saying that not everything was successfully fixed. However, the most important thing is that researchers from various countries could not only present their research results but also share personal experience, make new collaboration contacts, get acquainted with other researchers' carried out research and projects. In addition, a short visual material prepared by Vincentas Lamanauskas is available here: <https://eu.zonerama.com/BalticSTE/Album/11567082>

The fourth symposium took place in Šiauliai in June 2021. A detailed information is given in the symposium internet cafe at: <http://balticste.com>.

FOURTH SYMPOSIUM: BalticSTE2021

Time is running relentlessly fast. The Fourth International Symposium was held on June 21-22 this year. The topic of the Symposium was “Science and technology education: Developing a global perspective”. More than 60 scientists from 18 countries participated in the symposium. Compared to the symposium, which took place in 2019, the geographical distribution of the participants is wide and diverse. Ukrainian, Serbian, Moldavian, Malaysian, Latvian, Slovak, etc., researchers participated in the symposium. Another important feature of the symposium is that it was held remotely/online due to the ongoing COVID-19 pandemic.

One of the ideas of this international symposium is to show that Baltic region countries also actively participate in natural science and technology education research, especially in the STEAM context. The second idea is that Baltic countries, as well as other small regions of the world, need corresponding close communication and cooperation. During this symposium, these two essential ideas were developed and supported.

The symposium was organised by the scientific methodological centre “Scientia Educologica”, an associated member of the Lithuanian Scientific Society. The main symposium partner was Publishing House Scientia Socialis, Ltd. It is significant that even in the conditions of a pandemic, the symposium was properly organized.

This time the symposium lasted for two days. The first day of the symposium began traditionally with the opening of the symposium. Instead of traditional musical greetings, a short movie about Lithuania was shown to participants (“Lithuania in 4 minutes”, <https://www.youtube.com/watch?v=Hf81Cq1ONIo>). The symposium participants were also welcomed (remotely) by the IOSTE chairperson, Dr. Agnaldo Arroio (University of Sao Paulo, Brazil).

Four main (plenary) reports were planned in the symposium. Plenary report subjects comprised a very wide spectrum of natural science and technology education problems. It was discussed about Cognitive processes, Sustainable development, Chemistry education, and Mathematics education.

Plenary presentation authors, presentation topics are given in Table 11.

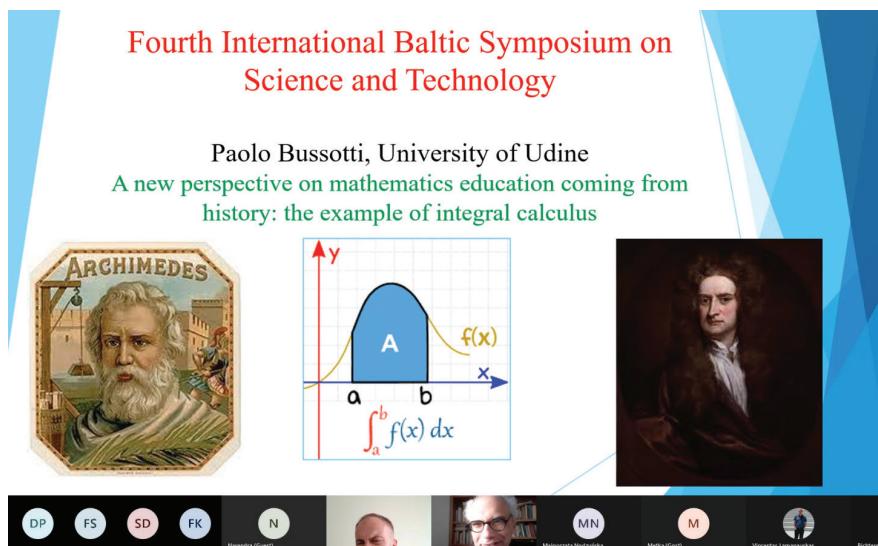
Table 11
Information about Plenary Presentations

Speaker	Topic
Prof. dr. Małgorzata Nodzyńska Pedagogical University of Cracow, Poland	CHEMICAL VS. NATURAL: COMMON MISCONCEPTIONS
Prof. Dr. Paul Pace University of Malta, Malta	THE SUSTAINABLE DEVELOPMENT GOALS: MAKING SCIENCE AND TECHNOLOGY GLOBALLY RELEVANT
Dr. Paolo Bussotti University of Udine, Italy	A NEW PERSPECTIVE ON MATHEMATICS EDUCATION COMING FROM HISTORY: THE EXAMPLE OF INTEGRAL CALCULUS
Prof. Dr. Peter Demkanin Comenius University in Bratislava, Slovakia	COGNITIVE PROCESSES IN THE THEORY OF PHYSICS EDUCATION

Two plenary presentations were made on the first day of the symposium.

Figure 54

Keynote Presentation by Paolo Bussotti



Dr. P. Bussotti's presentation explored the possibilities of using the history of mathematics in mathematics education (Figure 54). It has been shown in the concrete case of integral calculus, the way in which the history of mathematics could be used in an educational context. Bussotti emphasised that a historical approach to mathematics education is highly recommendable.

Figure 55

Keynote Presentation by Paul Pace



The next plenary presentation was made by Dr Paul Pace from the University of Malta (Figure 55). The presentation was focused on the Sustainable Development Goals (SGD). The main idea in this presentation was how to make science and technology globally relevant. Some clear results through science and technology were achieved, for example, increased control over environmental factors limiting the growth of the human population, spread of urbanisation, improved sanitation and health services, etc. The speaker also mentioned global tensions, for example, reduction in global poverty and rising vulnerability, interconnected world and insecurity, economic growth and climate change, etc.

The plenary was followed by 10 presentations on a wide range of topics. A list of presentations is given in Table 12.

Table 12

Information about Session 1 Presentations

Speaker's Name and Surname Entity/Academy represented	Topic of presentation
NYET MOI SIEW University Malaysia Sabah, Malaysia	Mentor-Mentee outreach program: Revitalizing STEM education in rural secondary schools
LETTAH SIKHOSANA University of South Africa, South Africa	The development and implementation of the sustainable intervention strategies for solid waste management in primary schools: A case of Nkangala district, Mpumalanga province
SAŠA HORVAT University of Novi Sad, Serbia	Procedure for assessment of the cognitive complexity of the problems with a limiting reactant
ILVA CINITE, GIRTS BARINOVIS University of Latvia, Latvia	Increased student performance on physics concept inventory test after student-centred instructions in universities of Latvia
YI WEN LO, CHIH-HSIUNG KU National Dong Hwa University, Taiwan	Exploring the effectiveness and impacts of using different media to learn science
ANGELA JAMES University of KwaZulu-Natal, South Africa	How COVID-19 was an enabler for Biological Sciences pre-service teachers' Service-Learning projects
TODAR LAKHVICH Belarusian State Medical University, Belarus	Improvement of the Course Design: Graph-Theory Based Approach in the Case of Organic Chemistry
ROSELINE NYABOKE The University of Toledo, USA	Examining the Use of Scientific Modeling by the Graduate Teachers in a Science Methods Course
MICAÍAS A. RODRIGUES Federal University of Piauí, Brazil	Challenges for teacher education in pandemic times
SOLANGE LOCATELLI Federal University of ABC, Brazil	Drawings to learn science - some reflections

The themes of Paul Pace's presentation were continued in the section reports. One of them was by researchers from South Africa (Figure 56). The development and implementation of sustainable intervention strategies in schools were discussed.

Figure 56

Presentation by L. Sikhosana and A. Mudau, South Africa

THE DEVELOPMENT AND IMPLEMENTATION OF THE SUSTAINABLE INTERVENTION STRATEGIES FOR SOLID WASTE MANAGEMENT IN SCHOOLS

Miss Lettah Sikhosana
Prof. Awelani V. Mudau

UNISA

1. **INTERVENTION STRATEGY 1**
• The school has a solid waste management system in place.
• There are clear guidelines for waste management.
• There are separate waste management facilities and they are implemented to manage waste effectively.

2. **INTERVENTION STRATEGY 2**
• The school has a solid waste management system in place.
• There are clear guidelines for waste management.
• There are separate waste management facilities and they are implemented to manage waste effectively.

3. **INTERVENTION STRATEGY 3**
• The school has a solid waste management system in place.
• There are clear guidelines for waste management.
• There are separate waste management facilities and they are implemented to manage waste effectively.

4. **INTERVENTION STRATEGY 4**
• The school has a solid waste management system in place.
• There are clear guidelines for waste management.
• There are separate waste management facilities and they are implemented to manage waste effectively.

5. **INTERVENTION STRATEGY 5**
• The school has a solid waste management system in place.
• There are clear guidelines for waste management.
• There are separate waste management facilities and they are implemented to manage waste effectively.

Slide 1 of 20 English (South Africa)

12:01 2021/06/21

The researchers from Serbia have focused on chemistry teaching issues, particularly the procedure for assessing the cognitive complexity of problems with a limiting reactant (Horvat et al., 2021) (Figure 57). Meanwhile, researchers from the University of Latvia (Figure 58) have been looking at issues of teaching physics at the university (Cinite & Barinovs, 2021).

Figure 57

Presentation by Dr. Saša Horvat, Republic of Serbia



BalticSTE '21 21-22, June

Procedure for Assessment of the Cognitive Complexity of the Problems With a Limiting Reactant

Horvat A. Saša, Rodić D. Dušica, Rončević N. Tamara, Trifunović Horvat M. Bojana,
e-mail: sasa.horvat@dh.uns.ac.rs

**Figure 58**

Presentation by Ilva Cinite, Latvia



Increased student performance on physics concept inventory test after student-centred instructions in universities of Latvia



BalticSTE '21

Ilva Cinite, Girts Barinovs
Faculty of Physics, Mathematics and Optometry, University of Latvia, Riga, Latvia

Figure 59
Symposium Poster



4th International Baltic Symposium on Science and Technology Education
(BalticSTE2021)

SCIENCE AND TECHNOLOGY EDUCATION: DEVELOPING A GLOBAL PERSPECTIVE

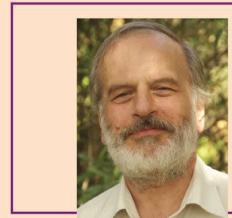
21-22 June 2021, Siauliai, Lithuania
(Online)

Website: <https://www.balticste.com> **E-mail:** balticste@gmail.com

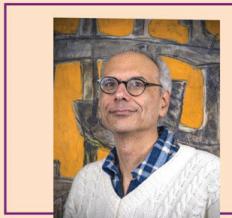
PLENARY SPEAKERS



Prof. dr. Małgorzata Nodzyńska
Pedagogical University of Cracow, Poland
CHEMICAL VS. NATURAL: COMMON MISCONCEPTIONS



Prof. dr. Paul Pace
University of Malta, Malta
THE SUSTAINABLE DEVELOPMENT GOALS: MAKING SCIENCE AND TECHNOLOGY GLOBALLY RELEVANT



Dr. Paolo Bussotti
University of Udine, Italy
A NEW PERSPECTIVE ON MATHEMATICS EDUCATION COMING FROM HISTORY: THE EXAMPLE OF INTEGRAL CALCULUS



Prof. Dr. Peter Demkanin
Comenius University in Bratislava, Slovakia
COGNITIVE PROCESSES IN THE THEORY OF PHYSICS EDUCATION

Symposium Website:
<http://balticste.com/>

Supporting Journals
Journal of Baltic Science Education
Problems of Education in the 21st Century
Gamtamokslinis ugdymas / Natural Science Education
Svietimas: politika, vadyba, kokybė / Education Policy, Management and Quality

Symposium Organizers





Despite insignificant technical issues, all scheduled presentations were made on time. An in-depth discussion took place, and various questions were raised. As usual, the proceedings of the symposium were prepared and published (Figure 59 & 60).

Figure 59
Symposium Publication Cover

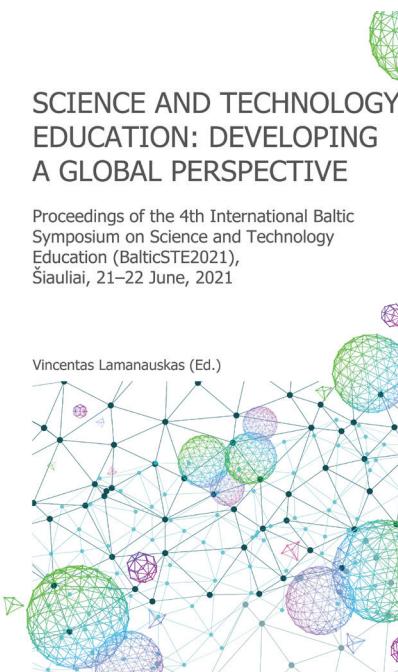


Figure 60
Symposium Publication Title Page



The second day of the symposium was again devoted to the two plenary presentations and Session 2.

Figure 61
Keynote Presentation by Małgorzata Nodzynska



Dr. Małgorzata Nodzinska made the next plenary presentation on a topical subject – chemical versus natural (Figure 61). Some selected common beliefs about the harmfulness of the so-called substances and health-promoting properties of natural substances were shown. Obviously, some beliefs are true, and some are incorrect from the scientific point of view. For example, the statement (belief) that brown (cane) sugar is healthier than white sugar. The main argument is that brown sugar is natural, and white sugar is obtained in a factory. The speaker noted that, based on the studies carried out, it is evident that a large percentage of society does not have basic knowledge on this subject. In addition, the influence of age and gender on the beliefs of the respondents was not noticed (Nodzynska, 2021).

Figure 62

Keynote Presentation by Peter Demkanin



Dr Peter Demkanin's presentation was focused on the cognitive processes in the theory of physics education (Figure 62). In particular, the presenter highlighted the importance of deeper conceptual understanding. According to the speaker, physics courses require thinking, using correct words, not making too much algebra and calculation mistakes, using arguments. According to Demkanin, the process of teaching physics content is quite often regarded as a process from a naive representation of normative knowledge via instructions (Demkanin, 2018).

Thirteen reports were presented during the second session (Table 13). There was also an interesting presentation by Antuni Wiyarsi, which focused on important issues in chemistry teaching. Particular attention was paid to student motivation and chemical literacy (Figure 63). Another presentation was made by researchers from Serbia (Figure 64) and also focused on chemistry education, specifically on algorithmic approach to quantitative problem solving in chemistry (Rodic et al., 2021).

Table 13
Information about Session 2 Presentations

Speakers Name and Surname Entity/Academy represented	Topic of presentation
ANTUNI WIYARSI Yogyakarta State University, Indonesia	Students' motivation and chemical literacy on context-based learning: A case of chemical bonding topic
DUŠICA RODIĆ University of Novi Sad, Serbia	To what extent do students rely on an algorithmic approach to quantitative problem-solving in chemistry?
NAFAA CHBILI United Arab Emirates University, UAE	Best practices for geometry teaching and learning
TEREZA HROUZKOVÁ, LUKÁŠ RICHTEREK Palacký University Olomouc, Czech Republic	Lawson classroom test of scientific reasoning at entrance university level
NARENDRAG DESHMUKH Homi Bhabha Centre for Science Education, TIFR, India	The effective use of technology in classrooms for implementing remedial modules to overcome students' misconceptions
MARKÉTA BARTOŇOVÁ, DANA KRIČFALUŠI Charles University, Czech Republic	Worksheets for integrated science
RITA BIRZINA, DAGNIJA CEDERE University of Latvia	Students' readiness for Massive Open Online Courses (MOOCs) in Latvia
MIHAEL CALALB Tiraspol State University, Moldova	Assumption of cognitive goals in science learning
KALLE SAASTAMOINEN, ANTTI RISSANEN National Defence University of Finland, Finland	Technology majors' methodology education – comparison of two course approaches
KAREL KOLÁŘ Prometheus, spol. s r. o., Czech Republic	Overview of participation in correspondence competitions (of CZE and SVK) in recent years with a discussion of possible positive and negative effects of COVID-19
ONDREJ VENCALEK Palacky University Olomouc, Czech Republic	How to motivate high school students to study statistics
KĀRLIS GREITĀNS, DACE NAMSONE University of Latvia, Latvia	In-service science teachers' professional development targeted to promote student conceptual understanding: A review study
POLONA LEGVART, METKA KORDIGEL ABERŠEK, MAJA KERNEŽA University of Maribor, Slovenia	Primary students' natural science digital literacy competence in digital learning environments

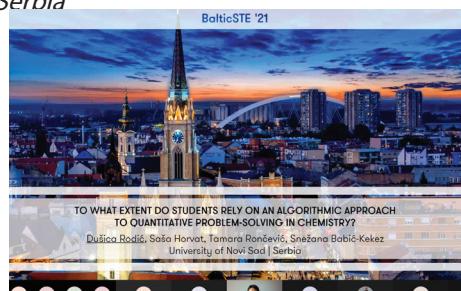
During the whole symposium, researchers from various countries shared their insights on possible further collaboration. All the symposium papers are published as an open access Symposium Proceedings. It is gratifying that even in the conditions of a pandemic, researchers from different countries can communicate, share experiences, develop academic contacts. This is ensured by today's technical possibilities and solutions. However, this does not change the format of a direct, conventional scientific event.

Figure 63

Presentation by Antuni Wiyarsi, Indonesia

**Figure 64**

Presentation by Dušica Rodić, Republic of Serbia



Thus, the fourth symposium leaves only good impressions and valuable experience. A short report about the Symposium is available on Facebook at: <https://www.facebook.com/media/set/?vanity=ScientiaEducologica&set=a.4700337219983677>

In addition, some video records are available on Facebook:

<https://www.facebook.com/ScientiaEducologica/videos/1675575459498563>
<https://www.facebook.com/ScientiaEducologica/videos/1185072511970190>
<https://www.facebook.com/ScientiaEducologica/videos/1648088482062778>
<https://www.facebook.com/ScientiaEducologica/videos/3808862679338065>
<https://www.facebook.com/ScientiaEducologica/videos/3892220264239869>
<https://www.facebook.com/ScientiaEducologica/videos/132463888987769>
<https://www.facebook.com/ScientiaEducologica/videos/865080267415137>

It can be said that all the published papers are open-access and available online:
 CEEOL
<https://www.ceeol.com/search/book-detail?id=981533>
 ResearchGate
https://www.researchgate.net/publication/354967606_SCIENCE_AND_TECHNOLOGY_EDUCATION_DEVELOPING_A_GLOBAL_PERSPECTIVE
https://www.academia.edu/54384965/SCIENCE_AND_TECHNOLOGY_EDUCATION_DEVELOPING_A_GLOBAL_PERSPECTIVE
 SCRIBD
<https://www.scribd.com/document/526826875/SCIENCE-AND-TECHNOLOGY-EDUCATION-DEVELOPING-A-GLOBAL-PERSPECTIVE>
 Internet Archive
<https://archive.org/details/baltic-ste-21-proceedings>
 Publisher's website:
https://scientiasocialis.lt/files/BalticSTE21_Proceedings.pdf

Although the quarantine conditions complicated the usual symposium, the remote event was a great success. The fifth symposium took place in Šiauliai in June 2023. A detailed information is given in the symposium website: <http://balticste.com>

FIFTH SYMPOSIUM: BalticSTE2023

The fifth BalticSTE2023 Symposium took place in Šiauliai on 12-15 June this year. Time passes inexorably, which is why this symposium can be called an anniversary symposium. It was also important that the symposium was held in the usual/regular format, i.e. face-to-face. It is worth remembering that this is a biennial scientific event of importance not only in the Baltic region but certainly internationally. Due to the COVID-19 pandemic, the fourth symposium was held remotely. A review of this symposium has also been published (Lamanauskas, 2021). By the way, reviews of previous symposia have also been published (Lamanauskas, 2015; 2017; 2019). The symposium's fundamental aim is to promote science and technology education. Moreover, it is an excellent tool to disseminate research findings as well as to build collaboration and cooperation network. Another important aim is to show that Baltic region countries also actively participate in natural science and technology education research, especially in the STEAM context. In addition, Baltic countries, as well as other small regions of the world, need corresponding, close communication, and cooperation. During this symposium, all these essential ideas were developed and supported.

Scientific events (e.g. symposia) are clearly significant in many senses. As noted by Hauss (2020), usually, they bring together a complex network of academic and non-academic experts to discuss and disseminate new knowledge in a particular area of science. The COVID-19 pandemic has understandably disrupted, to some extent, the organisation and running of normal scientific events such as conferences and symposia. We had to adapt to the new conditions and move towards academic events in a distance (online) format. On the other hand, much has been learnt, many challenges have been overcome, and the advantages and disadvantages of both models have become more fully apparent. However, whether virtual, blended, or other formats, whether venue-based or remote, it is clear that science events will remain an important aspect of academic life for the foreseeable future (Donlon, 2021).

The Fifth International Symposium was held on June 12-15 this year. The topic of the Symposium was “Science and technology education: New developments and innovations”. More than 50 scientists from 18 countries participated in the symposium. The geographical spread of the symposium's participants is quite wide. Researchers from Brazil, Croatia, Czech Republic, Estonia, Finland, Italy, Latvia, Poland, Serbia, South Korea, Taiwan, etc.

The symposium was organised by the scientific methodological centre “Scientia Educologica”, an associated member of Lithuanian Scientific Society. The main symposium partner was Šiauliai County Povilas Višinskis Public Library. Šiauliai Technology Training Centre was also an important partner of the symposium. The main sponsor of the symposium was Publishing House Scientia Socialis, Ltd.

This time, the symposium lasted for four days. The first day of the symposium began traditionally with the opening of the symposium, including traditional musical greetings. The Musical Greeting "Festival of Beetles" by the ensemble of Šiauliai nursery-kindergarten "Three Dwarfs" was presented. The children were prepared by the art education teacher Ernesta Saveikienė.

Eight main (plenary) reports were planned in the symposium (Figure 3). Plenary report subjects comprised a very wide spectrum of natural science and technology education problems. It was discussed about Cognitive processes, Sustainable development, Engineering pedagogy, and Teachers' education.

Plenary presentation authors, presentation topics are given in Table 14.

Table 14

Information about Plenary Presentations

Speaker	Topic
Prof. dr. Ching-Ching Cheng <i>National Chiayi University, Taiwan</i>	IMPLEMENTING A NATIONAL DATABASE ON YOUNG CHILDREN'S LEARNING: A LONGITUDINAL STUDY TO EVALUATE THE QUALITY OF PRESCHOOLS
Prof. dr. Andris Broks <i>University of Latvia, Latvia</i>	HUMAN, LIFE, UNIVERSE: HUMAN'S LIFE WITHIN THE UNIVERSE
Prof. dr. Gabriel Gorghiu <i>Valahia University Targoviste, Romania</i>	PROMOTING SCIENCE ACTIONS IN NOWADAYS EDUCATION: AN IMPORTANT ISSUE RELATED TO OPEN SCHOOLING
Mg. phys. Ilva Cinite <i>University of Latvia, Latvia</i>	STUDENT-CENTERED EDUCATION IMPLEMENTATION IN UNDERGRADUATE PHYSICS COURSES OF NATURAL SCIENCES AT THE UNIVERSITY OF LATVIA: SUCCESSES AND CHALLENGES
Prof. dr. Jari Lavonen <i>University of Helsinki, Finland</i>	LEARNING SCIENCE THROUGH PROJECT-BASED LEARNING: US-FINNISH PARTNERSHIPS FOR INTERNATIONAL RESEARCH AND EDUCATION (PIRE)
Dr. Paolo Bussotti <i>University of Udine, Italy</i>	INTRODUCING THE CONCEPT OF ENERGY: EDUCATIONAL AND CONCEPTUAL CONSIDERATIONS
Assoc. prof. dr. Tiiia Rüütmann <i>Tallinn University of Technology, Estonia</i>	ENGINEERING PEDAGOGY AND TEACHERS' COMPETENCIES FOR EFFECTIVE TEACHING STE
Assoc. prof. dr. Predrag Pale <i>University of Zagreb, Croatia</i>	WHICH TEACHERS NEED TO BE REPLACED BY AI

On the first day of the symposium, there was an opening ceremony and three plenary presentations (Figure 65 and Figure 66). In addition, poster presentations were made throughout the symposium. Also, on the first day of the symposium, the work was organised in two sessions with a total of 10 presentations (Table 15 and Table 16).

Table 15
Information about Session 1 Presentations

Speaker's Name and Surname Entity/Academy represented	Topic of presentation
Angela James <i>Kwazulu-Natal University, South Africa</i>	Learning, sharing and growing: Science in community engagement
Małgorzata Nodzyńska-Moroń, Vladimír Sirotek <i>University of West Bohemia in Pilsen, Czech Republic</i>	The durability of formal knowledge and its restructuring during lifelong learning
Hyoung-Yong Park, Hae-Ae Seo <i>Gyeongin National University of Education, South Korea; Pusan National University, South Korea</i>	The public's understanding of "Evolution" as seen through online spaces
Boris Aberšek, Metka Kordigel Aberšek <i>University of Maribor, Slovenia</i>	Transformation of education from dehumanization back to rehumanization
Vincentas Lamanauškas, Rita Makarskaitė-Petkevičienė <i>Vilnius University, Lithuania</i>	Environmental education in primary school: Meaning, themes and vision

Figure 65
Symposium Participants



Figure 66
Plenary Speech by Predrag Pale



Prof. dr. Ching-Ching Cheng from National Chiayi University (Taiwan) discussed about implementing a national database on young children's learning. Preliminary results of the longitudinal study were presented (Figure 67).

Figure 67*Plenary Speech by Ching-Ching Cheng*

The presenter emphasized that building a database on early childhood education can support scholarly research and serve as a crucial foundation for policy decisions. Databases for various uses can offer several ways to raise the standard of early childhood education (Cheng & Cheng, 2023).

Professor Jari Lavonen from the University of Helsinki (Finland) introduced an interesting topic on learning science through project-based learning (Figure 68).

Figure 68*Plenary Speech by Jari Lavonen*

The presenter pointed out that learning science through project-based learning (PBL) is relevant because it enhances student engagement by making scientific concepts hands-on and applicable to real-world problems. It fosters critical thinking, collaboration, and problem-solving skills essential for academic success and future STEM careers.

The third plenary presentation of the first day was given by Professor Tiiia Rüütmann from Tallinn University of Technology (Estonia). The topic of the presentation was engineering pedagogy and teachers' competencies for effective teaching science and technology (Figure 69).

Figure 69
Plenary Speech by Tiiia Rüütmann



According to Rüütmann (2023), it's a common misconception that engineering graduates need to be "ready-made," seasoned engineers. Professional experience, which should be obtained after graduation, is the foundation of engineering education. Therefore, firms also bear responsibility for training modern engineers. In collaboration with universities, they should provide university graduates with additional training that equips them with the fundamental knowledge and abilities needed in real-world working environments.

Figure 70
Symposium Poster



Despite insignificant technical issues, all scheduled presentations were made on time. An in-depth discussion took place, various questions were raised.

Table 16
Information about Session 2 Presentations

Speaker's Name and Surname Entity/Academy represented	Topic of presentation
Rita Birzina, Dagnija Cedere, Sandra Kalnina University of Latvia, Latvia	Learning skills acquired at school for STEM studies at the university
Martin Bilek Charles University, Czech Republic	The out-of-school science education in the international perspective: The project DOSLECTEP
Kalle Saastamoinen, Antti Rissanen, Arto Mutanen National Defence University, Finland	Intelligent learning in studying and planning courses – new opportunities and challenges for officers
Giovanni Scataglia Botelho Paz, Solange Wagner Locatelli Federal University of ABC, Brazil	The natural sciences curriculum of the city of São Paulo: Conceptions of teachers who teach natural sciences in the early years of elementary school

The second day of the symposium was traditionally dedicated to interactive learning activities. The symposium participants travelled to Žemaitija (Samogitia) (Figure 71). Samogitia is one of Lithuania's most interesting ethnographic regions. In addition, Samogitia is one of the five cultural regions of Lithuania and formerly one of the two core administrative divisions of the Grand Duchy of Lithuania alongside Lithuania proper.

Figure 71
Trip Information



The first destination was Plunge. The participants visited the Samogitian Art Museum (Samogitian Art Museum) operating in Mykolas Oginskis Palace since 1994 (Figure 71 & Figure 73). Later, a visit to the Plunge's Technology and Business School was made to learn about the educational process. Plunge's Technology and Business School was established in 1987. Since the beginning of the school's establishment, more than 6000 students have finished this school.

Figure 72
Presentation of the M. Oginskis Palace in After the Visit to the Žemaičiai Art Museum Plunge



Figure 73

After the two visits, the symposium participants had lunch at a traditional Lithuanian tavern, a 20-year-old family restaurant near the Vėžaičiai-Plungė road (Figure 74). The tavern has a cosy "home" atmosphere. The owner has created the rustic style and every detail of the interior "from the soul" herself. "The energy of the wood, which dominates the details, soothes a customer who is tired after work or just stopping by for lunch.

In the afternoon, the symposium participants continued their excursion. The Plunge's School of Art was visited (Figure 75). This excellent school is named after Mykolas Oгинskis, a Duke, diplomat, and political figure of the Republic of the Two Nations (Polish–Lithuanian Commonwealth). Participants toured the school and listened to music performed by students.

Figure 74

After the Lunch in Karčema / Tavern



Figure 75

Visiting Plunge's Mykolas Oгинskis Art School



The last object in this route was the Samogitian Village Museum in Telšiai town (Figure 76 & Figure 77). It is a subdivision of the Samogitian Museum "Alka", which was established in the 1960s in the southwestern part of the shore of Lake Mastis, on an area of 8.5 ha. The museum has 16 buildings, comprising three farmhouses and a public sector. They reflect the late 19th and early 20th century. The buildings, which date from the 19th century to the 19th century, represent the rural landscape of Samogitia.

Figure 76

Visiting Samogitian Village Museum



Figure 77

Introduction to the Samogitian Museum "Alka"



The third day of the symposium was as busy as ever in the academic sense. Four plenary presentations were made, reflecting a wide range of topics. These were reports made by P. Pale (Croatia), G. Gorghiu (Romania), P. Bussotti (Italy), and I. Cinite (Latvia).

Professor Gabriel Gorghiu from Valahia University Targoviste (Romania) discussed open schooling issues (Figure 78). The main idea of the presentation was how to promote science actions in nowadays education.

Figure 78

Plenary Speech by Gabriel Gorghiu



According to Gorghiu, the promotion of science actions in modern education refers to efforts aimed at enhancing science learning, engagement, and application in schools and communities. This includes implementing hands-on, inquiry-based methods like Project-Based Learning (PBL), integrating STEM (Science, Technology, Engineering, and Mathematics) programs, and encouraging participation in science fairs, experiments, and research projects (Olteanu & Gorghiu, 2023).

Professor Paolo Bussotti from the University of Udine (Italy). The presenter remained committed to the history of science (Figure 79).

Figure 79

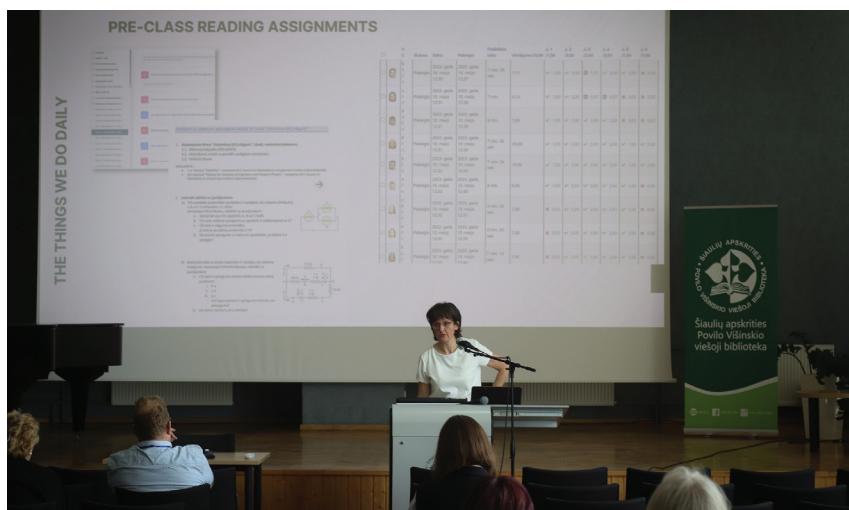
Plenary Speech by Paolo Bussotti



Since energy is present in every aspect of physics, it is most likely the most significant idea in the field. According to Bussotti (2023), it includes rest energy, chemical energy, atomic energy, electric energy, thermal energy, mechanical energy, and gravitational energy. The presenter emphasized that it is appropriate to explain the concept of energy using a historical method before going into the mathematical details of the many kinds of energy. This is because it is especially suitable for the students to grasp the substance of this notion, which is so crucial in physics.

The last plenary presentation on the third day of the symposium also dealt with current issues in physics education. It was made by Ilva Cinite, a researcher at the University of Latvia (Figure 80).

Figure 80
Plenary Speech by Ilva Cinite



The presenter introduced a relevant topic related to the student-centered education implementation in undergraduate physics courses of natural sciences at the University of Latvia. According to Cinite, student-centered education in undergraduate physics courses of natural sciences is relevant because it shifts the focus from passive learning to active engagement, improving conceptual understanding and problem-solving skills.

In addition, on the same day, work was carried out in three sections with a total of 15 presentations (Table 17).

Table 17
Presentations from Sessions 3, 4 and 5

Speaker's Name and Surname Entity/Academy represented	Topic of presentation
<i>Third session</i>	
Maja Kerneža <i>University of Maribor, Slovenia</i>	Fundamental and basic cognitive skills required for teachers to effectively use Chatbots in education
Dejan Zemljak <i>University of Maribor, Slovenia</i>	Advanced tools for skill development: Learning preparations using ChatGPT
Jelena Kosmaca, Ilva Cinite, Girts Barinovs <i>University of Latvia, Latvia</i>	Exploring interactive H5P video as an alternative to traditional lecturing at the physics practicum
Jovita Ponomariovičė <i>Vytautas Magnus University, Lithuania</i>	Competency-based science education: the case of one Lithuanian school
Jan Francisti, Zoltán Balogh, Milan Turčáni <i>Constantine the Philosopher University in Nitra, Slovakia</i>	The use of internet of things technology in the pedagogical process
<i>Fourth session</i>	
Young-Joon Shin, Hyunju Park, Hae-Ae Seo <i>Gyeongin National University of Education, South Korea; The War Memorial of Korea, South Korea; Pusan National University, South Korea</i>	The influence of a project-based club program on middle school students' action competency in responding to climate change
Gabriel Gorghiu, Mihai Bîzoi, Laura Monica Gorghiu, Claudia Lavinia Burileanu <i>Valahia University of Targoviste, Romania</i>	Students' perceptions and attitudes regarding science following the implementation of the "Rewilding" science action
Sabina Wierszewska-Duraj <i>University of Natural Sciences and Humanities, Poland</i>	The effectiveness of ecological education of children in the research concept of Celestyn Freinet
Radu Lucian Olteanu, Gabriel Gorghiu <i>Valahia University of Targoviste, Romania</i>	Increasing the students' interest in science by implementing a science action dedicated to plastics biodegradability
Solange Locatelli <i>Federal University of ABC, Brazil</i>	Drawings to learn chemistry: Limits and possibilities
<i>Fifth session</i>	
Saša A. Horvat, Tamara N. Rončević, Ivana Z. Bogdanović, Dušica D. Rodić <i>University of Novi Sad, Republic of Serbia</i>	Differences in graphic illustrations in the contents of natural sciences in regular textbooks and textbooks for students with special educational needs in the Republic of Serbia
Marcella Seika Shimada, Solange Wagner Locatelli <i>Federal University of ABC, Brazil</i>	Students' perception of an inquiry-based metavisual activity about concepts of chemical kinetics
Agneš R. Sedlar, Tamara N. Rončević, Saša A. Horvat <i>University of Novi Sad, Republic of Serbia</i>	The application of interactive learning tasks made by using digital hybrid illustrations in the topic "Hydrocarbons" in eighth-grade organic chemistry classes
Tamara N. Rončević, Saša A. Horvat, Dušica D. Rodić, Ivana Z. Bogdanović <i>University of Novi Sad, Republic of Serbia</i>	Secondary school students' perception of biochemistry concepts by using word association test
Carla Patricia Araujo Florentino, Marcella Seika Shimada, Solange Wagner Locatelli <i>Federal University of ABC, Brazil</i>	Prior knowledge about science from drawings by a group of deaf students

The third day of the Symposium concluded with the Symposium Dinner, which took place in Naisiai (Figure 81). Naisiai is one of the most visited villages, famous not only within Šiauliai district but all over Lithuania. The Balts' Arena is one of the most important, impressive, and largest objects in Naisiai (Figure 82). In other words, it's an open-air museum that's great fun to visit.

Figure 81
In Naisiai Village



Figure 82
Exploring the Balts' Arena



The fourth and final day of the symposium was dedicated to interactive activities. The keynote interactive presentation was given by Prof. Andris Broks (University of Latvia), with the assistance of colleagues from other countries (Figure 83).

Figure 83
Interactive Speech by Andris Broks



According to Broks (2023), the foundation of scientific thinking and science education is systems thinking, which is scientific philosophy and scientific psychology for contemporary science as well as creative and practical education for the future.

We had a really interesting and rich debate, as well as a discussion of the symposium. The last day of the symposium took place at Šiauliai Technology Training Centre (Figure 84). The Centre organised two workshops for the symposium participants: Floristic educational activities and Photography educational activities (Figure 85). The symposium participants had a unique opportunity to learn about the composition of bouquets, as well as photo art activities.

Figure 84

At Šiauliai Technology Training Centre



Figure 85

After the Workshops



During the whole symposium, researchers from different countries shared their insights on possible further collaboration. All the symposium papers were published as open access Symposium Proceedings (<https://www.ceeol.com/search/book-detail?id=1123290>). Also, it is freely available on Research Gate: https://www.researchgate.net/publication/371666351_Science_and_technology_education_New_developments_and_innovations_Proceedings_of_the_5th_International_Baltic_Symposium_on_Science_and_Technology_Education_BalticSTE2023 and ERIC (Institute of Education Sciences): <https://eric.ed.gov/?q=BalticSTE&id=ED629086>.

In summary, the work of the Symposium was meaningful and fruitful. Academic experiences were shared, and new contacts were made. Thus, the fifth symposium leaves only good impressions and valuable experience. The symposium can be at least partially accessed on the YouTube channel, where the main video material is posted (Table 18).

Table 18*Information on the Dissemination of the Symposium*

Title	URL
Presentation by Boris Aberšek, Slovenia	https://www.youtube.com/watch?v=-PegPC4dIVw
Presentation by Jari Lavonen, Finland	https://www.youtube.com/watch?v=Uqtp88lXbMw
Outdoor activities / Excursion, 13 June 2023	https://www.youtube.com/watch?v=kwZ0htmEjjM
Presentation by Andris Broks, Latvia	https://www.youtube.com/watch?v=Tt-AoAdS7G8
Presentation by Paolo Bussotti, Italy	https://www.youtube.com/watch?v=Cq8a_AHYImU
Presentation by Ching-Ching Cheng, Taiwan	https://www.youtube.com/watch?v=rm2hhlejJQ
Presentation by Gabriel Gorghiu, Romania	https://www.youtube.com/watch?v=y3Tysb7tqrw
Presentation by Tia Rüttermann	https://www.youtube.com/watch?v=jT3pwenDw9I
Presentation by Zoltan Balogh, Slovakia	https://www.youtube.com/watch?v=YGxxnrak2HE
Workshops I and II	https://www.youtube.com/watch?v=fYUdgMDTECU
Presentation by Predrag Pale, Croatia	https://www.youtube.com/watch?v=LSpfZxH9Lio
Presentations_Section 5	https://www.youtube.com/watch?v=qFKkH9HAxcM
Presentation by Ilva Cinite, Latvia	https://www.youtube.com/watch?v=LZF3KIlfMbY
Presentations_Section 1	https://www.youtube.com/watch?v=Ms-Y4Mt0Kr0
Symposium Overview	https://www.youtube.com/watch?v=J-mv5Tw7_1g

All in all, it was an intense symposium, useful in every sense. It not only presents the latest research results but also fosters scientific cooperation between researchers from different countries. It is clear that the contacts established during the symposium between researchers from Lithuania and other countries will not only be a definite incentive for the exchange of new ideas but will also create an opportunity for joint research projects.

The 6th Symposium took place in Šiauliai in June 2024. Detailed information is given on the symposium website: <http://balticste.com>

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ANNEXES

ANNEXES



Annex 1. Thematic list of all published symposium papers, organized by year**2015**

NATURAL SCIENCE AND TECHNOLOGY EDUCATION: “RESETTING” MEANING

Vincentas Lamanauskas

THEORETICAL INVESTIGATION OF THE IMPLICATIONS OF COMPLEX SYSTEMS THEORY FOR TEACHING SCIENCE

Parvin Bazghandi, Saeid Zarghami-Hamrah, Yahya Ghaedi, Alireza Mahmudnia, Khosrow Bagheri Noaparast

THE 1ST YEAR STUDENTS' READINESS FOR STUDIES: THE CASE OF THE FACULTY OF BIOLOGY AT UNIVERSITY OF LATVIA

Rita Birzina, Dagnija Cedere

THE USEFULNESS OF PHYSICS FORMULAS IN THE OPINION OF STUDENTS. AN EYETRACKING STUDY

Władysław Blasiak, P. Kazubowski, Roman Rosiek, Miroslawa Sajka

A STUDY ON SCIENCE EDUCATION IN ITALY

Virginia Brianzoni, Liberato Cardellini

THE STUDY OF COMPUTATIONAL GEOMETRY IN THE SYSTEM *MATHEMATICA*

Aliya Bukusheva

WHAT LESSON OBSERVATION DATA REVEAL ABOUT THE CHANGES IN TEACHING SCIENCE: CASE STUDY FROM LATVIA

Liga Cakane, Jelena Volkinstiene, Dace Namsone, Ilze France

COGNITIVE INTEREST: PROBLEMS AND SOLUTIONS IN THE ACQUISITION OF SCIENCE AND MATHEMATICS IN SCHOOLS OF LATVIA

Dagnija Cēdere, Inese Jurgena, Ineta Helmane, Inta Tiltiņa, Gunita Praulīte

THE DEVELOPMENT OF FACTORS AFFECTING THE USAGE OF EDUCATIONAL SOFTWARE IN CHEMISTRY EDUCATION IN THE CZECH REPUBLIC

Kateřina Chroustová, Martin Bílek

THE USE OF ICT IN THE SCIENCE LESSONS: EXPERIENCE FROM LATVIA

Inese Dudareva, Dace Namsone, Liga Cakane

FIRST STEPS IN ASSESSMENT OF STUDENTS' INQUIRY: A CASE STUDY OF NON-EXPERIENCED CHEMISTRY TEACHER

Karol Dudek, Paweł Bernard, Ewa Odrowąż

TRANSDISCIPLINARITY IN EDUCATION IS NEAR

Andrej Flogie, Kosta Dolenc, Boris Aberšek

SOME ASPECTS OF THE CONSTRUCTION OF THE THEMATIC TESTS FOR THE DIAGNOSIS OF COGNITIVE LEARNING OUTCOMES CHEMISTRY ENGINEERING STUDENTS

Liudmila Gorbunova

EXAMINING EFFECT OF ANIMATION APPLICATIONS ON STUDENT ACHIEVEMENT IN SCIENCE AND TECHNOLOGY COURSE

Sedat Yüksel, Mestan Boyaci

AN APPROACH TO TEACHING MEDICAL CHEMISTRY THAT HIGHLIGHTS INTERDISCIPLINARY NATURE OF SCIENCE

Aris Kaksis, Agnese Brangule, Mihails Halitovs

USAGE OF CRITICAL THINKING PRINCIPLES IN MEDICAL CHEMISTRY COURSE

Irina Kazuša

CONTENT LINES IN DESIGN OF CHEMICAL EDUCATION FOR WOULD-BE ENGINEERS

Vitali Khaletski

ONLINE SCIENCE LITERACY: TO TEACH OR NOT TO TEACH

Metka Kordigel Aberšek

STUDENTS' ATTITUDE REGARDING USE OF FRAYER MODEL IN THE DEVELOPMENT OF THE COMPREHENSION OF CHEMISTRY CONCEPTS

Silvija Kreile

THE ROLE OF GAME ELEMENTS IN CHEMISTRY ACQUIREMENT

Emilija Lesina, Sandra Kalnina

ACQUISITION OF SCIENTIFIC AND PEDAGOGY COMPETENCES BY PRIMARY PRE-SERVICE TEACHERS: MYTH OR REALITY?

Abdeljalil Météoui, Louis Trudel

A FLASH OF CONSTRUCTION SCHEMES COLLECTIVE IN THE CLASSROOM INVOLVING THE FIELD STRUCTURAL MOLECULAR

Marcelo Gouveia Nascimento, Gabriel Nicolas Garcia Alves, Marco Antonio Bueno Filho, Rodrigo Luiz Oliveira Rodrigues Cunha

EVALUATING THE POTENTIALS OF ICT INTEGRATION IN TEACHING WITH THE AIM OF INTENTIONALLY DEVELOPING COMPETENCIES FOR THE 21ST CENTURY IN PUPILS

Mateja Ploj Virtič, Kosta Dolenc

THE IMPLEMENTATION OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN SCHOOLS OF LATVIA

Juris Porozovs, Anita Migleniece, Daina Voita, Alvis Valdemiers

DISCUSSION OF VISUAL ATTENTION FOR SOLVING MULTIPLE CHOICE SCIENCE PROBLEM: AN EYE-TRACKING ANALYSIS

Miroslawa Sajka, Roman Rosiek

DESIGNING A BLENDED LEARNING ENVIRONMENT TO SUPPORT SELF-DIRECTED AND SELF-REGULATED LEARNING

Aysan Şentürk

THE ROLE AND SCOPE OF VISION THERAPY IN EDUCATIONAL PRACTICE

Violeta Šlekienė, Loreta Ragulienė

DEVELEPMENT OF COMPUTER-BASED EDUCATIONAL GAME ACROSS COMPUTER SCIENCE CURRICULUM

Dzintars Tomsons, Inta Znotiņa

DEVELOPMENT OF SCIENCE TEACHER CREATIVITY AND IBSE

Eva Trnava, Josef Trna

THE DISCUSSION AS A METHOD TO TEACH PHYSICS AT THE UNIVERSITY

Louis Trudel, Abdeljalil Météoui

INNOVATION SKILL DEVELOPMENT POTENTIAL OF TEACHING PROGRAMMING TO CHILDREN IN THE CONTEXT OF THE STEM EDUCATION

Adem Uzun

ON VOLUME OF THE ANTI PRISM IN CUBE AS A COMPLEX MATHEMATICAL PROBLEM

Lukáš Vízek

CHEMISTRY OF PAINTINGS OR HOW TO INVOLVE 8-10 Y.O. CHILDREN FOR A TWO-HOUR SESSION WITHOUT BREAKS

Denis M. Zhilin, Marina Tokareva

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Vincentas Lamanauskas

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Zuzana Balázsiová

COLLABORATION BETWEEN PHYSICS AND CHEMISTRY TEACHERS AND EXPERT: A CONTRIBUTION TO TEACHERS' PROFESSIONAL DEVELOPMENT

Mónica Baptista

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Martin Bílek, Jiri Rychtera, Katerina Chroustová

A REFLECTION OF PRESERVICE SCIENCE TEACHERS' VIEWS OF OPEN ACCESS DIMENSION OF RESPONSIBLE RESEARCH AND INNOVATION

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DELIBERATE PRACTICE: HOW TO TEACH PROBLEM SOLVING IN A MEANINGFUL WAY

Liberato Cardellini

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SUPPORTING CONCEPTUAL LEARNING IN ORGANIC CHEMISTRY THROUGH SEMI-EMPIRICAL MOLECULAR MODELING: HEURISTICS OF DIELS-ALDER [4+2] CYCLOADDITIONS FOR PREPARATION OF POTENTIAL TLR4 MODULATORS

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2021

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THE PUBLIC'S UNDERSTANDING OF "EVOLUTION" AS SEEN THROUGH ONLINE SPACES
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THE NATURAL SCIENCES CURRICULUM OF PUBLIC NETWORK OF SÃO PAULO: CONCEPTIONS OF TEACHERS WHO TEACH NATURAL SCIENCES IN THE EARLY YEARS OF PRIMARY SCHOOL
Giovanni Scataglia Botelho Paz, Solange Wagner Locatelli

SECONDARY SCHOOL STUDENTS' PERCEPTION OF BIOCHEMISTRY CONCEPTS BY USING WORD ASSOCIATION TEST
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INTELLIGENT LEARNING IN STUDYING AND PLANNING COURSES – NEW OPPORTUNITIES AND CHALLENGES FOR OFFICERS
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THE APPLICATION OF INTERACTIVE LEARNING TASKS MADE BY USING DIGITAL HYBRID ILLUSTRATIONS IN THE TOPIC "HYDROCARBONS" IN EIGHTH-GRADE ORGANIC CHEMISTRY CLASSES
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STUDENTS' PERCEPTION OF AN INQUIRY-BASED METAVISUAL ACTIVITY ABOUT CONCEPTS OF CHEMICAL KINETICS
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THE INFLUENCE OF A PROJECT-BASED CLUB PROGRAM ON MIDDLE SCHOOL STUDENTS' ACTION COMPETENCY IN RESPONDING TO CLIMATE CHANGE
Young-Joon Shin, Hyunju Park, Hae-Ae Seo

MENDELEEV EPONYMS IN THE EPOCH OF EDUCATIONAL ETHNOCENTRISM
Uladzimir Slabin

Annex 2. Bibliographic List of Published Symposium Proceedings from 2015 to 2023

Publication	Links
Lamanauskas V., Šlekienė V., Ragulienė L. (Eds.) (2015). <i>State-of-the-Art and Future Perspectives. Proceedings of the 1st International Baltic Symposium on Science and Technology Education (BalticSTE2015)</i> . Scientia Socialis Press, Šiauliai. ISBN: 978-609-95513-2-6.	https://www.ceeol.com/search/book-detail?id=940820 https://archive.org/details/baltic-ste-2015-proceedings https://www.calameo.com/books/0072439189ebab603dc75 https://doi.org/10.33225/BalticSTE/2015
Lamanauskas, V. (Ed.) (2017). <i>Science and technology education: Engaging the new generation. Proceedings of the 2nd International Baltic Symposium on Science and Technology Education (BalticSTE2017)</i> . Scientia Socialis Press, 144p. ISBN 978-609-95513-4-0.	https://www.ceeol.com/search/book-detail?id=941411 https://www.calameo.com/books/007243918b9e1fd762523 https://doi.org/10.33225/BalticSTE/2017
Lamanauskas, V. (Ed.). (2019). <i>Science and technology education: Current challenges and possible solutions. Proceedings of the 3rd International Baltic Symposium on Science and Technology Education (BalticSTE2019)</i> (pp. 1-254). Scientia Socialis Press. ISBN 978-609-95513-6-4 / Print/, ISBN 978-609-95513-5-7 /Online/.	https://www.ceeol.com/search/book-detail?id=942413 https://eric.ed.gov/?q=BalticSTE&id=ED619611 https://www.calameo.com/books/007243918897d33f75462 https://doi.org/10.33225/BalticSTE/2019
Lamanauskas, V. (Ed.) (2021). <i>Science and technology education: Developing a global perspective. Proceedings of the 4th International Baltic Symposium on Science and Technology Education (BalticSTE2021)</i> (pp. 1-184). Scientia Socialis Press. ISBN 978-609-95513-7-1 /Print/, ISBN 978-609-95513-8-8 /Online/.	https://www.ceeol.com/search/book-detail?id=981533 https://eric.ed.gov/?q=BalticSTE&id=ED620289 https://archive.org/details/baltic-ste-21-proceedings https://www.calameo.com/books/0072439189e106a46720a https://doi.org/10.33225/BalticSTE/2021
Lamanauskas, V. (Ed.) (2023). <i>Science and technology education: New developments and Innovations. Proceedings of the 5th International Baltic Symposium on Science and Technology Education (BalticSTE2023)</i> (pp. 1-266). Scientia Socialis Press. ISBN 978-609-96384-0-9 /Print/, ISBN 978-609-96384-1-6 /Online/.	https://www.ceeol.com/search/book-detail?id=1123290 https://eric.ed.gov/?q=BalticSTE&id=ED629086 https://www.calameo.com/books/007243918b220c294cc89 https://archive.org/details/balticSTE23/1-4.Cover-EB_Baltic-STE23 https://doi.org/10.33225/BalticSTE/2023

Annex 3. List of keynote speakers and topics of presentations

Name & surname	Presentation title	Affiliation & Country
BalticSTE2015		
Martin Bilek	Synergy and/or mismatch of real and virtual environment in science education	University of Hradec Králové, Czech Republic
Paolo Bussotti	How history of mathematics can be used in mathematics education to teach differential and integral calculus	Commission for the Publication of the National Edition of Federigo Enriques's Works, Italy
Metka Kordigel-Aberšek	Online science literacy – teach or not to teach	University of Maribor, Slovenia
Kuohung Huang	Mobile learning and outdoor science education: Studies of zoo field trips	National Chiayi University, Taiwan
Liberato Cardellini	A study on science education in Italy	Marche Polytechnic University, Ancona, Italy
BalticSTE2017		
Agnaldo Arroio	Science and technology education: A Brazilian perspective	University of São Paulo, Brazil
Andris Broks	Systems thinking: Joint philosophical and psychological basis for modern science and technology education	University of Latvia, Latvia
Angela A. James	Science education in South Africa: Engaging the new generation of student teachers in service-learning for sustainable development	University of KwaZulu-Natal, South Africa
Jonas Jasaitis	The role of scientists in formation of state strategy	Šiauliai University, Lithuania
Raffaele Pisano	On the epistemic interplay between physics and mathematics such as a dynamical framework within NOS–research teaching science	CIREL, Lille 3 University, France
Miaa Rannikmae	Incorporating career awareness with motivational education through science approach: Two alternative foci	University of Tartu, Estonia
BalticSTE2019		
Andris Broks	Changes all around us and within science education	University of Latvia, Latvia
Todar Lakhvich	One chemistry - two meanings. science and education: comparative analysis of the roles, presentation, and applications	Belarusian State Medical University, Republic of Belarus
Solange W. Locatelli	Metacognitive strategies in science and technology education: Limits and possibilities	Federal University of ABC, Brazil
Małgorzata Nodzynska	Analysis of Piaget's theory influence on the teaching of science	Pedagogical University of Cracow, Poland

Dusica Rodic	Combined measures of students' success: Recent trends and developments in science education research	University of Novi Sad, Republic of Serbia
Tiia Rüütmann	Engineering pedagogy science as the contemporary basis of effective teaching science and technology	Tallinn University of Technology, Estonia
BalticSTE2021		
Paolo Bussotti	A new perspective on mathematics education coming from history: The example of integral calculus	University of Udine, Italy
Peter Demkanin	Cognitive processes in the theory of physics education	Comenius University in Bratislava, Slovakia
Malgorzata Nodzynska	Chemical vs. natural: Common misconceptions	Pedagogical University of Cracow, Poland
Paul Pace	The sustainable development goals: Making science and technology globally relevant	University of Malta, Malta
BalticSTE2023		
Andris Broks	Human, life, universe: Human's life within the universe	University of Latvia, Latvia
Paolo Bussotti	Introducing the concept of energy: Educational and conceptual considerations	University of Udine, Italy
Ilva Cīnīte	Student-centered education implementation in undergraduate physics courses of natural sciences at the University of Latvia: Successes and challenges	University of Latvia, Latvia
Ching-Ching Cheng	Implementing a national database on young children's learning: A longitudinal study to evaluate the quality of preschools	National Chiayi University, Taiwan
Gabriel Gorghiu	Promoting science actions in nowadays education: An important issue related to open schooling	Valahia University Targoviste, Romania
Jari Lavonen	Learning science through project-based learning: US-Finnish partnerships for international research and education (PIRE)	University of Helsinki, Finland
Predrag Pale	Which teachers need to be replaced by AI	University of Zagreb, Croatia
Tiia Rüütmann	Engineering pedagogy and teachers' competencies for effective teaching STE	Tallinn University of Technology, Estonia



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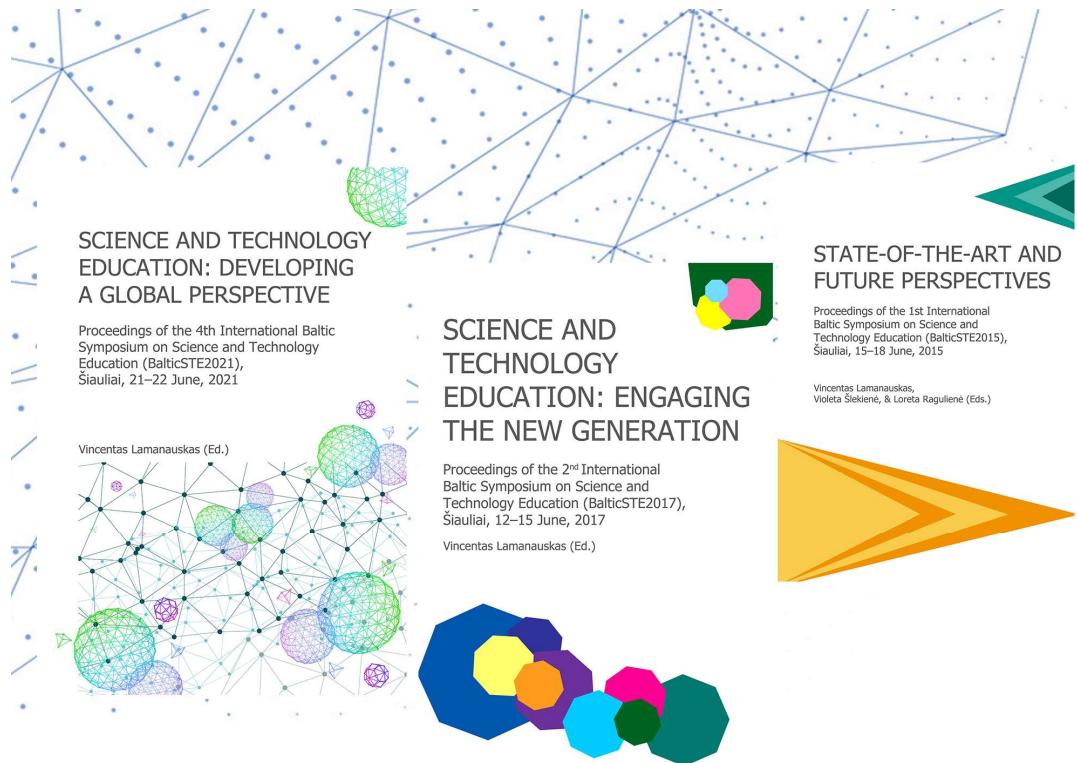
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